COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

August 1953

Boiler drum enroute to New York City subway power station; Brooklyn Bridge in background

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Feature Articles

Editorials

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COMBUSTION

Editorials

The Scope of College Research

Engineering college research is becoming a major enterprise with annual expenditures in recent years reaching the $65,000,000 level. Details of the activities at 103 schools are set forth in the recently published "Review of Current Research and Director of Member Institutions" prepared by the Engineering College Research Council of the American Society for Engineering Education. More than thirty of these colleges, with their allied research institutes, have annual outlays of $500,000 or more, and at least sixteen spend in excess of a million dollars a year.

Approximately seventy-five hundred research projects are reported, covering work in all branches of engineering and most related fields. Noticeable particularly in the larger schools is the great preponderance of income from research conducted for the military branches of the government. In quite a number of instances such work represents anywhere from seventy to ninety per cent of the total research budget.

With national defense needs accounting for so much college research, it may be well to assess the long run picture. What will happen if, as already seems likely, government research expenditures are curtailed as an economy measure? Is there any possibility of an over-expansion of research facilities, at least in relation to applied research? How much duplication of effort is involved in current activities? Answers to these questions may have an important bearing on the future well-being of engineering college research.

Korean Truce Not Likely to Affect Power Plans

With the signing of an armistice in Korea some people have expressed the opinion that there will be curtailment in power demands by defense industries of sufficient magnitude to modify present plans for expansion of power generating capacity. However, such a reaction does not appear well founded when the situation is viewed broadly.

In the first place, in the light of previous experience, there is no assurance that the truce will bring about a lasting settlement. As high military authorities have cautioned, the necessity remains for continuing to build up and maintain a high state of preparedness as insurance against fresh aggression. This was reflected in the large military budget recently passed by the Congress.

Ultimately, as defense goals are approached and an adequate stock of atomic weapons has been built up such power demands should fall off, despite the possible development of new processes involving large blocks of power. But such a situation will come about gradually and any such slack in demand is likely to be taken up by normal growth in civilian demand which for some years past has shown a steady annual increase of eight to ten per cent.

While there may be occasional lulls in demand, of short duration, these should not affect the long-range view; and there is little at present to indicate that the Korean armistice will exercise a major influence.

Program Making

This is an old subject which has been discussed in these columns before; but it warrants reiteration. Are engineering and scientific society programs becoming unduly large and too complex? Some believe they are; others revel in their bigness. Here are a few typical examples:

The National meeting of the American Chemical Society, to be held early in September at Chicago, has scheduled close to thirteen hundred papers. The ASME, including regional and professional-division meetings, is responsible for about six hundred papers annually, of which its Annual Meeting accounts for nearly half. At the recent ASEE meeting in Gainesville, Fla., educators listened to over two hundred papers. A comparable situation exists with the AIEE and other engineering societies.

The net result is that in most cases, because of the expense involved, many of the papers are not printed and only a fraction of those presented ever reach the transactions to become available for reference. Furthermore such extensive programs tend to crowd sessions, thus limiting helpful discussion, and make necessary many simultaneous sessions which often preclude attendance by those who have interest in two or more.

Also by reason of their total physical volume, individual papers receive less attention and are more apt to be overlooked when a part of a massive program than when presented on a smaller and more selective program. In comparing paper listings of one society with another, substantial duplication of subject matter and presentations by the same authors are often in evidence. Of course, there is some justification for this in that different (but sometimes overlapping) audiences are reached. Yet all too often the importance of a subject, even if of sufficient significance to warrant repetition, is lost when it is a part of a program having several hundred papers.

As has been pointed out before, timeliness, importance of a subject and the value of its contents should be the criteria in acceptance of a paper, regardless of the desire to fill a program, or of any commercial considerations. Although the present is an age of rapid progress and widespread engineering developments, it is difficult to conceive that they warrant so many society papers.

Methods for Cleaning Regenerative Type Air Preheaters—Part I

By JOSEPH WAITKUS

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In the light of recent developments resulting from a study of the formation of deposits and methods for controlling the rate of accumulation, it seems important to revise the author's recommendations in the March, 1942 issue of COMBUSTION for cleaning heating surface in regenerative-type air preheaters. In the earlier article well-known forms of cleaning equipment were described, and operating procedures and requirements were suggested, with special emphasis on washing the heating surface. Since then new types of cleaning equipment have been developed and introduced. With such equipment, new operating procedures and requirements have been established which assure more effective cleaning with minimum expense for maintenance in the replacement of heating surface and rotor seals. These are discussed here and in a second article to follow next month.

THE first important step in the establishment of the new concept for cleaning the regenerative-type air preheater was development of new cleaning devices. Fig. 1 illustrates two views of the manually operated single-nozzle oscillating type cleaning device. This provides a single high-velocity cleaning jet, the position of which is controlled by a manually operated feedscrew. The cleaning medium is admitted at either end of a hollow shaft, which, in turn, supports the nozzle pipe. A rotary joint in the piping system directly connected to the hollow shaft permits oscillating the nozzle on an arc over the edges of the heating surface.

Advantages of the single-nozzle arrangement over the former multi-jet soot blower are obvious. Concentration of the full force of the cleaning medium into the heating surface permits effective action in the removal of deposits. The fact that the cleaning jet can be moved to any point over the heating surface provides a high degree of flexibility. It permits directing special attention to the areas of the heating surface where it is most necessary. This feature assumes particular importance in installations where, due to non-uniform air and flue gas distribution, heavy deposits accumulate in certain areas of the rotor. The device can be installed in either the air or flue gas stream. Temperature is not a limiting factor in the application of this device because the parts exposed to elevated temperatures can be made of alloy materials.

From the design standpoint the single-nozzle cleaning device has several interesting features. All actuating parts are outside the preheater structure and away from the influence of dirt and heat in the air or flue gas stream. Simple construction, highlighted by few parts, makes the device desirable from the standpoint of cost. Consideration was given to accessibility to the most important parts for maintenance. The entire assembly may be removed for a major repair or complete replacement without interrupting the preheater operation, although annual inspection and conditioning has been more than adequate to assure high availability and low maintenance expense.

The disadvantage of the manually operated single-nozzle type lies chiefly in the fact that it requires the continuous attention of an operator to see that the entire heating surface is covered by the cleaning action. In other words, the cleaning efficiency is largely dependent on the personal element. If the operator is careless or indifferent, it is obvious that the cleaning jet will not do a thorough job.

To overcome this, a power-operated, dual-nozzle, rotary-type cleaning device, as shown in Fig. 2, was developed. It consists essentially of a fractional horsepower electric, or air, motor coupled to a speed-reducer which, in turn, is geared to a driveshaft passing through a supporting tube to a pair of bevel gears, one of which is fastened to a special rotary joint. The cleaning medium is conducted through a pipe in the supporting tube to the rotary joint, and is distributed to two nozzles by a rotating element fastened to the rotary joint.

The cleaning action is smooth and continuous; it assures maximum cleaning efficiency by eliminating the personal influence; and adequate coverage of the entire

Fig. 1—Manually operated single-nozzle cleaning device

heating surface is assured by selecting the speed-reducer with consideration for the relative movement of nozzles with respect to the moving heating surface. The jets traverse the rotor width in 20 to 30 min, depending on the size of preheater, and the dual jet arrangement doubles the cleaning action for one complete traverse. If this is more cleaning than seems necessary, the nozzles can be stopped at the middle of the traverse and only half the time will then be consumed in the cleaning operation.

One important feature, sometimes overlooked in the application of the dual-nozzle, is the fact that the cleaning circle is tangent to the air preheater rotor areas where deposits accumulate most. The areas, shown in Fig. 3, are located at the outer rim and near the center of the rotor. At these two locations the position of the jet changes at a rapidly decreasing rate which automatically concentrates a great deal of cleaning action in the heavy deposit areas. The result is that the areas can be maintained in better condition at all times.

The power-operating facilities of the cleaning device are not complicated. The most important components, with one exception, are external to the preheater and can be easily maintained. The exception is the special rotary joint which cannot be reached when the air preheater is in operation. However, experience over a period of several years, indicates there is no need for concern over the condition of the rotary joint in its inaccessible position. The joint has stainless steel balls on chrome-plated races and is prelubricated with special

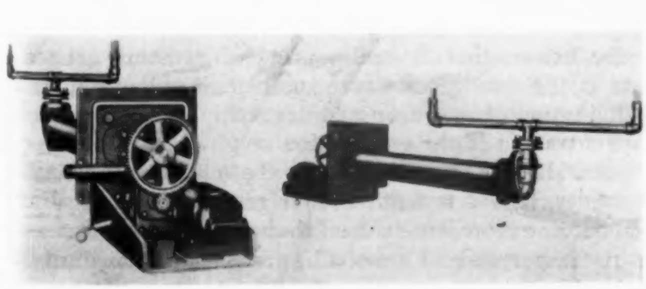

Fig. 2—Power-operated dual-nozzle cleaning device

grease. Excessive wear and binding is not likely to occur because rotation is very slow. Annual inspection has been found adequate for maintenance in practically all applications.

To illustrate the application of both cleaning devices to vertical and horizontal type regenerative air preheaters, Figs. 4, 5 and 6 were selected as typical examples. Fig. 4 illustrates a typical single-nozzle design application, whereas Figs 5 and 6 show the dual-nozzle design applied to vertical and horizontal type units, respectively.

Generally speaking, both devices are applicable to any of the regenerative-type air preheaters of early or late design. However, in certain cases conditions may exist which will limit the selection to only one type of cleaning device. For example, special construction features within the preheater structure, interference with equipment adjacent to the preheater structure, temperature to which the nozzle end of the device is exposed, ambient temperature in the area where the device is located, and accessibility to the device for operation and maintenance, are a few of the conditions which may influence the application.

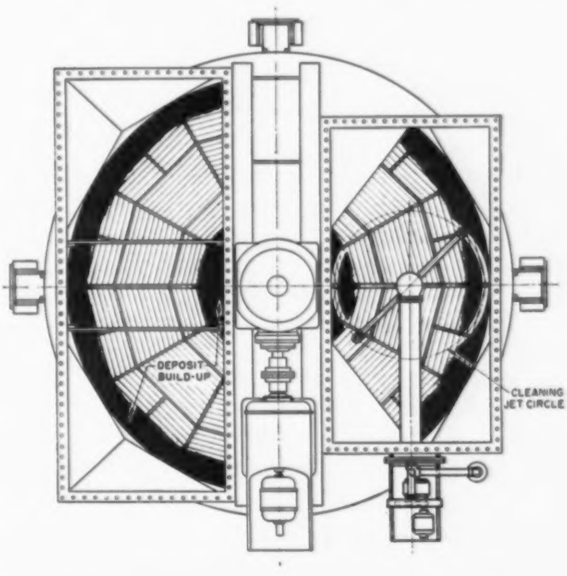

Fig. 3—Typical distribution of deposits showing dense accumulation at rotor post and rotor rim

For a time the chief disadvantage of the dual nozzle cleaning device was the fact that it could not be installed in the flue gas stream passing through the air preheater. It was assumed the rotary head which encloses the rotary joint, gears, bearing, etc., could not be safely subjected to temperatures in excess of 200 F, or excessive dirt. However, one installation has now been made in the gas outlet duct and no apparent difficulties have been reported. But, with such limited experience, the recommendation is to keep the device in the cold-air inlet duct.

Because of limitations encountered with both the manually operated single-nozzle and the power-operated dual-nozzle, the next development was the power-operated single-nozzle device illustrated in Figs. 7 and 8. This differs from the manually operated design of Fig. 1 in a number of basic features. The feedscrew is re-

placed with a lever and link-operated mechanism connected either directly to the output shaft of a speed-reducer, as shown in Fig. 7, or to a worm and worm wheel assembly interposed between a speed-reducer and linkage mechanism, as shown in Fig. 8. The former is designed for small applications, and the latter for large ones.

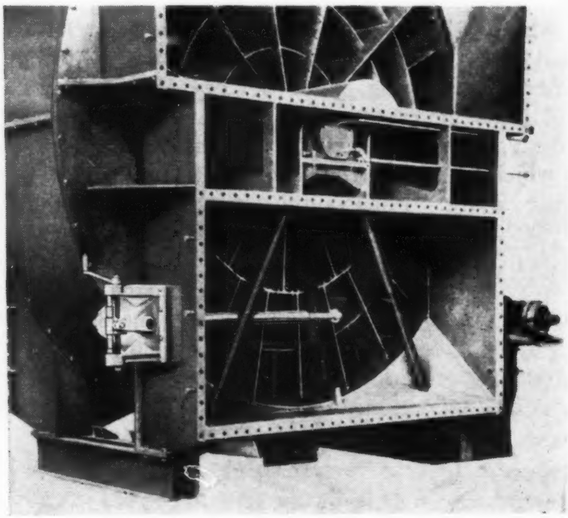

Fig. 4—Typical arrangement of manually operated single-nozzle cleaning device installed in air inlet of a horizontal air preheater

Flange connections at both ends of the oscillating shaft conform with acceptable piping practice. All bearings are prelubricated bronze bushings of generous size. The entire assembly is condensed to the smallest possible dimensions permitting easy installation under difficult conditions with respect to available space and interferences.

This device combines all the desirable features of the two previous devices, while eliminating the disadvantageous ones. Every component of the operating mechanism can be reached for adjustment and maintenance

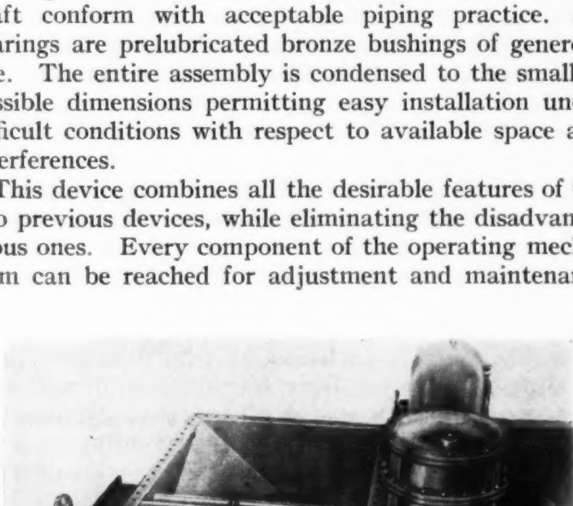

Fig. 5—Typical arrangement of power-operated dual-nozzle cleaning device in air inlet of a vertical air preheater

while the air preheater is in operation. There are no application limitations with respect to temperature because alloy materials can be used where necessary, with minimum expense. The power-operating feature eliminates the influence of personal attention, which is the weakness of the manually operated type.

Complete and thorough cleaning action is assured by a combination of power-operating components giving consideration for the relative speed of nozzle and heating surface. Although the shaded areas indicated in Fig. 3 do not receive quite the intense cleaning action with this device as with the dual-nozzle device, the cleaning efficiency has been more than adequate for satisfactory operating results.

Having described and compared the merits of some of the latest equipment developed for cleaning and heating surface of the air preheater, it seems logical at this point to discuss the cleaning media available today, and consider their respective merits. For the present the discussion will be confined to cleaning media for blowing purposes. Those for washing purposes will be covered separately, in a later article.

Blowing Media

Until a few years ago saturated steam was accepted universally as the best cleaning medium. It was readily available at safe pressures and temperatures, and, because of the ease with which it could be piped to the cleaning device, little, if any, consideration was given to other media such as superheated steam or compressed air.

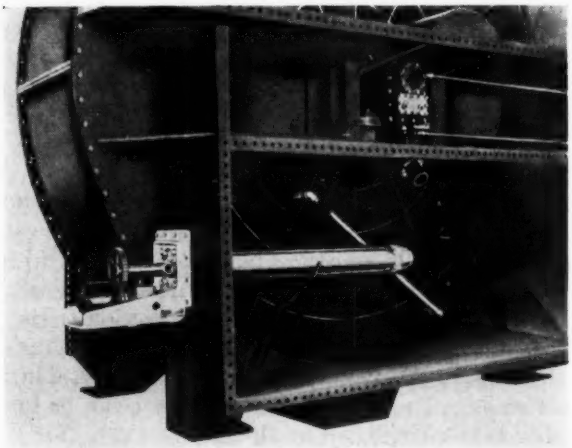

Fig. 6—Typical arrangement of power-operated dual-nozzle cleaning device in air inlet of a horizontal air preheater

Coupled to this wide acceptance of saturated steam was the general indifference to the influence of moisture in the formation of deposits.

It was common knowledge that, in the presence of moisture, ash particles entrained in the flue gases undergo a chemical change resulting in solid masses or deposits of varying character which adhere to surfaces with varying degrees of tenacity. It was furthermore generally known that several sources of moisture existed. One is the flue gases where moisture results from the combination of hydrogen and oxygen; another is moisture entrained in the combustion air; and still another, of considerable magnitude, is the cleaning medium. However, it was not until lower grades of coal and oil fuel became more widely used that attention was focused on the importance of a moisture-free cleaning medium.

Superheated steam was given logical consideration, and energetic efforts were made to convert to it in a num-

ber of installations. The effect on the cleaning efficiency was observed for an appreciable period, and it can be reliably stated now that superheated steam is a practical approach to the solution of the deposit buildup and cleaning problem. However, special considerations are necessary because of the elevated temperatures involved.

With superheated steam the standard low-temperature rotary joint could not be used safely because of excessive expansion and disintegration of the packing. Special joints were therefore developed, as illustrated in Fig. 9. The special designs utilize construction features which have successfully handled temperatures that range up to 900 F.

The steam pressure is not an important consideration because it is throttled or orificed down to maximum of 250 psig ahead of the rotary joint. High-pressure steam does permit use of smaller size piping, valves and fittings to the orifice. All rotary joints are of forged steel and may include stainless steel springs and balls, ball races plated to avoid corrosion and binding, carbon rings and special high-temperature packings. For comparison a cross-section of a standard low-temperature joint is included in Fig. 9.

The use of superheated steam often requires special attention with respect to piping, valves and fittings, and, depending on the steam conditions at the source, alloy materials may be required to meet the Piping Code. This, of course, results in an expensive arrangement. However, experience indicates that the additional cost is more than offset by higher cleaning efficiency and the longer operating life of the heating surface. Steam from a high pressure source can help offset the cost of expensive materials by permitting the use of smaller size valves, piping and fittings.

Cleaning with Compressed Air

Another dry cleaning medium which is currently receiving wide consideration as a solution to the moisture problem is compressed air. Unfortunately, it is not always readily attainable. It is expensive to provide compressed air in sufficient quantity and at a pressure suitable for the needs of most cleaning requirements. Large compressors and receivers are required, and, unless there are other uses for it, air cleaning the preheater can be an expensive operation. Typical piping arrangements for compressed air cleaning are illustrated in Fig. 10. Some advantage is gained over the use of superheated steam in that smaller pipe lines can be used, and alloy materials are not required. No insulation is necessary provided the compressed air is not heated.

In a few installations, arrangements were made to heat the air before it reached the cleaning device. A pipe coil was provided in the hot gas or hot air duct which served to elevate the compressed air temperature as much as 400 to 500 deg. F. Heating the air thus served to eliminate all moisture entrained therein, and, at the same time, it avoided the chilling effect of the air striking the heating surface. The chilling effect is the result of the drop in compressed air temperature at the nozzle outlet when the air expands into the atmosphere and a sudden change in pressure takes place. It is a debatable effect which has not been explored sufficiently, as yet, to establish true importance or significance.

The writer has no definite conclusion to offer at this time on the effectiveness or desirability of heated compressed air as a cleaning medium. The results have been complicated by numerous conditions, and a satisfactory comparison between hot and cold compressed air has not yet been developed. The idea is sound, but the results so far are not adequate to encourage the additional equipment and expense involved. Further experiments and tests seem necessary. Pending further developments

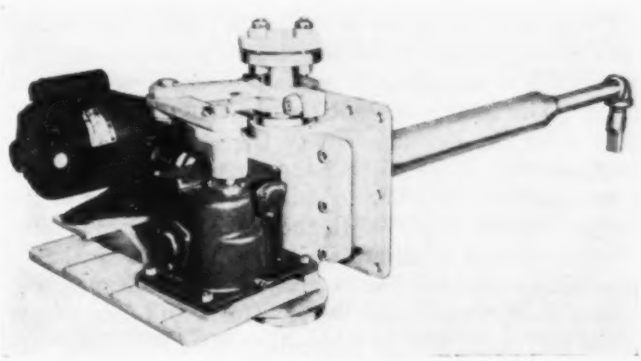

Fig. 7—Power-operated, single-nozzle cleaning device with direct connection to speed-reducer

it may be assumed, for all practical purposes, that the moisture and chilling effect are not serious enough to warrant heating the air. The moisture can be reduced to a very high degree, with line traps and separators and by drawing air from the top of the receiver. As for the chilling effect, there is reasonable doubt as to its ill effects on the heating surface and as a contributor to deposit buildup.

The question often arises as to which is the better cleaning medium, superheated steam or compressed air. As far as results are concerned, there is no decided advantage for either provided both are dry when they strike the heating surface. Each, however, as mentioned above, has special conditions to be met. For example,

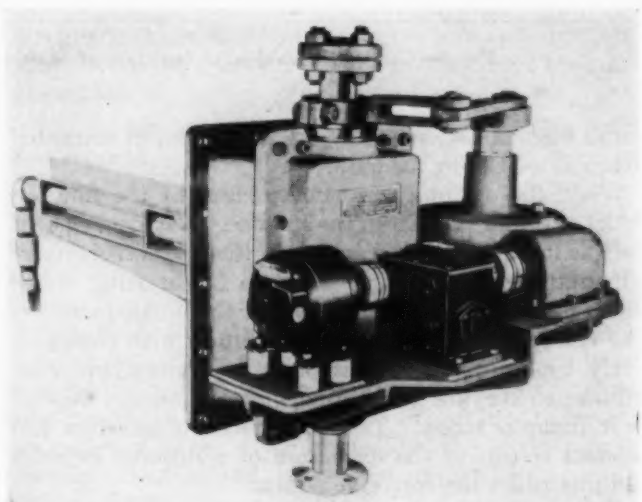

Fig. 8—Power-operated single-nozzle cleaning device with linkage mechanism and worm and worm-wheel drive

high temperature in the case of superheated steam requires alloy materials. In the case of compressed air, an expensive compressor and receiver are required to assure the quantity and pressure desired. Special equipment for a timed or interrupted blowing cycle may be

required to let the compressed air quantity and pressure build up in order to cover the heating surface with uniform cleaning effect. The choice between superheated steam and compressed air seems to hinge on which of the two media can be provided the easiest from the standpoint of cost.

Location of Cleaning Device

Thinking on the question: "Is the proper location for the cleaning device in the air stream or in the flue gas stream?" has undergone a number of changes in recent years. The first important change took place immediately after the development of the manually operated single-nozzle. Prior to the introduction of this device, it was standard practice to conduct the cleaning in the flue gas stream only. With the development of a more effective means of cleaning it was discovered that a decided advantage could be realized if the cleaning operation were conducted in the air stream and particularly at the air inlet of the air preheater. The reasoning supporting the change in cleaning position is logical and sound when considered from the standpoint of saturated steam as a cleaning medium.

When the attempt is made to clean at the flue gas outlet of the air preheater, the steam is discharged against the gas flow. As the steam losses its inertia, it is naturally returned by the flue gases to the starting point, which happens to be the cold end of the heating surface. The result is that the steam, in contact with comparatively cool surfaces at this point, condenses and contributes to keeping the heating surface, and any deposit on it, damp or moist. The combination of moisture and deposits results in the formation of additional deposits and intensifies the corrosive action.

Reversing the procedure and cleaning at the flue gas inlet results in practically the same condition. The steam, discharged into the hot end of the rotor is, at first, in contact with hot surfaces; as it passes through the depth of the surface with the flue gases and approaches the cold end, it comes in contact with progressively cooler surfaces; and finally, at the cold end of the surface, the steam condenses and again develops a damp or moist condition on the surface.

It was the above analysis which caused attention to be focused on the air side of the air preheater and disclosed it to be the more logical and practical location for a cleaning device using saturated steam. By installing the cleaning device at the air inlet the steam, moving with the air passing through the heating surface toward the hot end, comes in contact with progressively hotter surface. Condensation of the steam is avoided, and the heating surface and deposit is kept comparatively dry. Dry deposit is easier to remove from the cold end of the heating surface of an air preheater with action of the cleaning jet.

Transferring the cleaning operation to the air side soon gave rise to several questions with respect to the disposal of the dirt and the effect of dust-laden hot air on the general operation of the steam generating unit. Such questions as the following often come up for discussion:

1. What will happen to dirt discharged into the ductwork between the preheater and the burner windbox?
2. How will the burner operation be affected by the dust-laden air? Will dampers and controls stick?
3. What will be the effect of the cleaning nozzle discharge on the pressure in the duct, and the maintaining of a flame at the burner?
4. What effect will dust in the hot air have on the combustion of the fuel?
5. Will slagging conditions in the boiler be aggravated?

Numerous conditions influence the answer to each of these questions, but it seems the one having the greatest influence is the composition of the fuel, particularly with respect to ash content. The gradual decline in the use of high-grade fuels and the wide acceptance of certain imported oil fuels is increasing the ash content which is reflected, in turn, by a higher dust loading of the flue gases. This is emphasized by the current interest in dust collectors, and the universal consciousness of the need for better control of smoke nuisances.

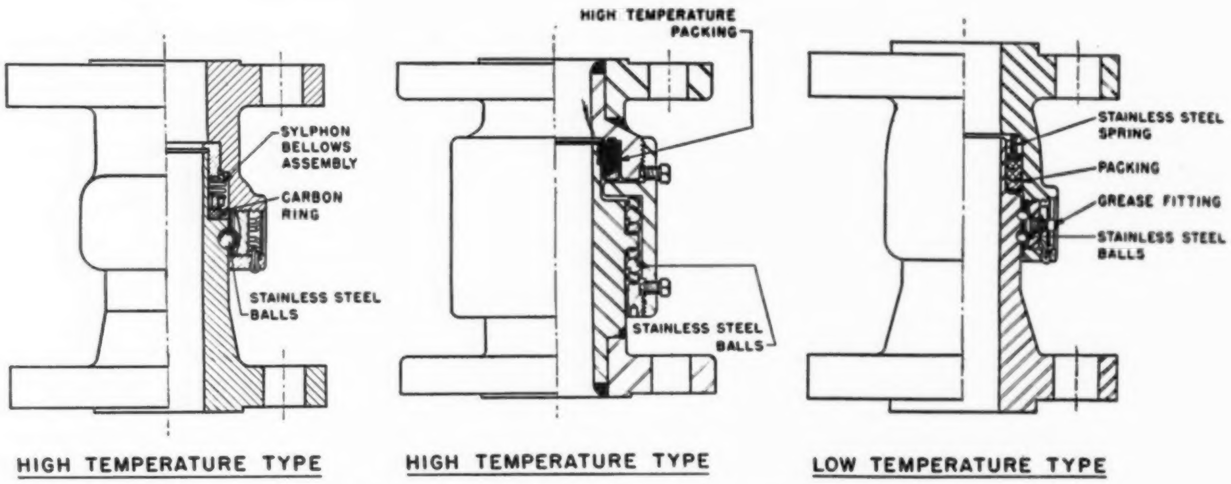

Fig. 9—Comparative design features of high-temperatuer and low-temperature rotary joints

Since the regenerative type air preheater has the inherent characteristic of carrying flue gases into the air stream, there is always a certain amount of dust in the hot air stream. Obviously, the poorer fuels serve to aggravate the situation with their higher ash content and dust discharge.

It follows from the foregoing that dust accumulation in the hot air duct and burner windbox is a direct function of the type, grade and composition of the fuel. Solid fuels are, of course, more troublesome than liquid fuels. The ash content of solid fuels is greater than that of liquid fuels. However, recent experience with certain grades of oil fuels has shown a definite rise in dust loading, although it rarely, if ever, reaches the amount produced by the best solid fuels available.

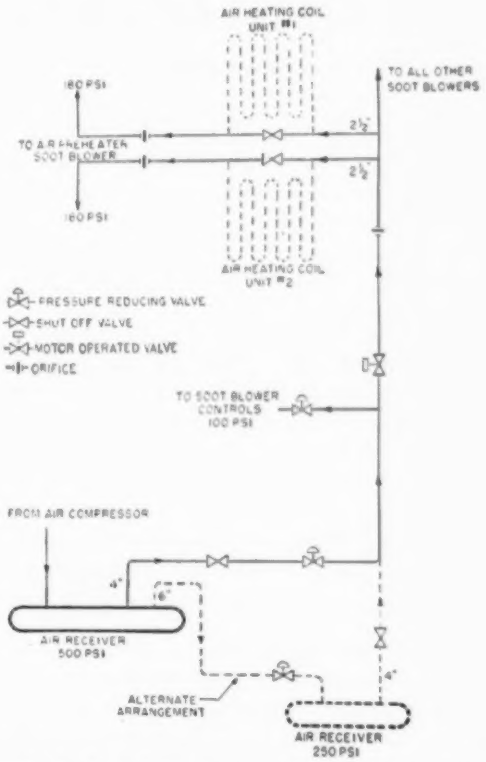

Fig. 10—Typical piping arrangements for compressed air blowing

Cleaning in the air stream has, in certain cases, caused an appreciable accumulation of dust in the ductwork but it has never been of such magnitude as to plug the passage or interfere with the operation of the boiler. The build-up has never been any more of a nuisance than that encountered with conventional hoppers placed at strategic points in the gas passes of the boiler. Annual inspection and cleanout seems to be more than adequate for all practical purposes. It has been found in most cases that the velocity of the hot air stream is sufficient to keep the dust moving and prevent it from settling except in regions of low eddy currents such as corners and shelves.

The effect of dust-laden air on dampers and burner operating mechanism also depends on the type, grade and composition of the fuel. In a few cases, when using oil fuels, the primary air dampers and the burner mechanism became difficult to operate due to the gummy deposit, characteristic of the type of fuel, which clung to certain movable parts. With coal the condition rarely exists, presumably because the deposit on the mechanism is generally a comparatively dry dust. The poorer the fuel, the more critical the nature of the deposit or dust, and the greater the nuisance.

Discharging the cleaning jet into the hot-air duct does force dust out of leaky duct joints and around poorly sealed portholes or mechanism openings in the burner windbox. However, by repairing the joints and correcting the sealing or packing, reduction or elimination of the nuisance is generally possible.

Snuffing Out Flame Not Due to Action of Cleaning Jet

Reports have been received to the effect that the burner flame was snuffed out as soon as the cleaning jet discharged into the air stream, but in each case the situation was found to be due to conditions in no way related to the cleaning device, or due to boiler operation at extremely low capacity when the burner flame is comparatively small. There is little, if any, danger of snuffing out the burner flame at boiler loads in excess of 25 per cent of maximum capacity.

The dust entrained in the hot air has no influence on the combustion of the fuel as far as can be determined. The dispersion is presumably too great and the quantity too small compared to the amount of fuel that is being consumed.

As for the effect of dust-laden air on slagging, there has been no noticeable change reported with respect to aggravating or reducing the slagging tendencies in the furnace. Again it is presumed the quantity of dust released is not sufficient to be considered seriously.

These conclusions are based on experiences with several hundred cleaning devices in air preheaters installed on various type of boilers operating under a wide range of conditions with respect to fuel, combustion rate, temperature and pressure of the air, quantity of air, etc. Exceptions do exist, but they are so few as to have no influence on the general opinions such as have been expressed above.

The reader must bear in mind that up to this point the arguments for blowing on the air side are based on the use of saturated steam as a cleaning medium. As superheated steam and compressed air became more easily available and were recognized as the ideal moisture-free cleaning media, the need for blowing on the air side became less important. In addition, the dust nuisance in the hot-air stream in some plants reached an intolerable state. These two facts combined to create a trend of switching back to blowing on the gas side. The trend grew rapidly as recognition of the importance of having less moisture in the cleaning medium and acceptance of superheated steam and compressed air increased.

Today approximately 70 per cent of the new installations are providing superheated steam or compressed air as a cleaning medium, with the cleaning device installed in the gas outlet of the air preheater. In addition many of the early installations are converting from air-side to gas-side blowing as one of the two dry cleaning media becomes available.

(Continued in the September issue)

Automatic Sampling of Coal at Car Dumper

By ARMAND BUR

Cleveland Electric Illuminating Co.

Description of a method of taking samples from the falling coal while the car is being dumped, as employed by the Cleveland Electric Illuminating Company. The method is fast, completely mechananized and automatic, and the samples check closely with hand-belt samples.

COAL is the largest single purchased item used by The Cleveland Electric Illuminating Company. Being a heterogeneous material by nature, its quality becomes even more variable when influenced by different methods of mining and loading. It contains up to 26 per cent of inert matter—such as moisture, pyrites, slate and bone. The difficult problem is to get a true sample as it exists on delivery, a sample which shows accurately the proportions of inert matter and coal in the entire carload. In a test run on three cars of slack coal to compare samples taken at three different levels in each car, i.e., top, middle and bottom, it was found that the ash content differed as much as 3 per cent between levels in the same car.

Fig. 1—General layout of sampler before crusher was installed

Car sampling must fit into the regular plant unloading schedule as undue car switching and delay might be costly both in operations and demurrage. Inclement weather, too, has its influence on both the sample and the person doing the sampling. Therefore, a new method of car coal sampling was developed, which reduced the sampling time from 1.33 to 0.10 man-hours per car.

Fig. 2—Cross-section of sampling pipe

One of the earlier methods employed for car sampling was the core method. With this the equipment consisted of a two-inch pipe, four feet long, a 10-lb sledge hammer, and a six-gallon bucket. The pipe was driven three feet into the car of coal. The pipe was then withdrawn and the core of coal lodged within the pipe was re-

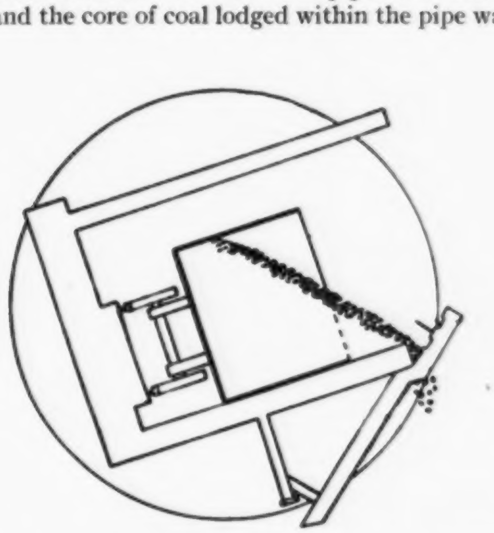

Fig. 3—Diagram illustrating coal from top of car missing all sampling ports

Fig. 4—Photograph illustrating coal from top of car missing all sampling ports

Fig. 6—Photograph illustrating coal from the middle of the upper half of car being sampled

moved and placed in the bucket. This was repeated at six different points in the car. The chief disadvantage in this method was the losing of some of the fines from the core as it was being withdrawn from the coal. The hard labor involved was another serious detriment. Hazards, inclement weather, and the slow rate of sampling was responsible for its abandonment.

A careful study of the coal-handling system revealed that the car dumper presented the most favorable conditions for sampling. The coal stream between the car and the dumper hopper is the only point in the system where coal is caused to flow while still retaining its mine identity. Once the coal falls into the car dumper hopper its mine identity is lost, since the hopper is a common surge bin for cars of coal previously dumped.

The car dumper was studied to see if some means of sampling could be employed in the process of dumping a car of coal. It was found that through the cycle of dumping, the coal started to flow after the car had rotated about 90 deg from its initial position, and emptying of the car was completed after it had rotated about 150 deg from its initial position. Since representation is the principle of all sampling, the next step was to link a sampling process with the angle of coal flow.

Three lengths of eight-inch pipe were attached to the dumper sidewall, spaced so as to get proper representation across a standard railroad car; see Fig. 1. Each of these three pipes was fixed at a given angle to cut through the falling stream of coal at right angles. Two openings or ports were cut in each of the three sampling

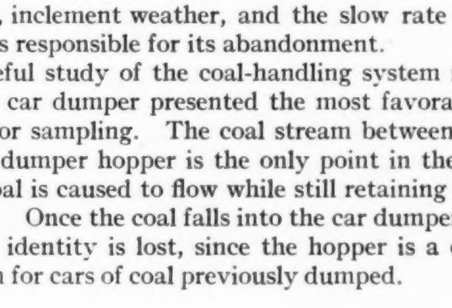

Fig. 5—Diagram illustrating coal from the middle of the upper half of car being sampled

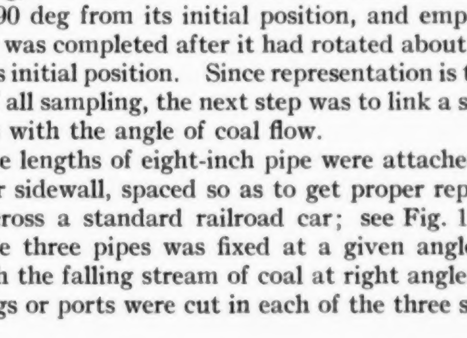

Fig. 7—Diagram illustrating coal from the middle of the lower half of car being sampled

Fig. 8—Photograph illustrating coal from the middle of the lower half of car being sampled

pipes, as indicated in Fig. 2, the ports being of sufficient size to pass a five-inch lump. Spacing of the ports coincide with a desired sample procurement relative to car depth. The sequence of operation is shown in the following figures.

Figs. 3 and 4 illustrate coal from the top of the car missing all sampling ports. However, it is not desirable to sample this part of the car since the top layer of coal may be affected by weather conditions.

Figs. 5 and 6 illustrate coal from the upper half of the car being sampled and Figs. 7 and 8 show coal from the lower half of the car being sampled.

As the dumper returns to the upright position, the sampling pipes approach a nearly vertical position and the sample gravitates to the hopper attached to the lower end of the pipes. The hopper gate opens automatically and discharges the coal sample into the sampling crusher.

The car-dumper sampler was checked for accuracy, using two single-car lots of coal, a five-car lot, a 16-car lot, and a 30-car lot of coal.

Table 1 shows the ash and moisture analysis of the single-car lot checks comparing the car-dumper sampler against hand-belt sampling. The size of coal sampled was mine run. The total weight of the car dumper sample was 108 lb taken in six increments, whereas the total weight of the hand sample was 48 lb taken in six increments.

TABLE 1

	Ash, Per Cent	Moisture, Per Cent
First Car		
Car-dumper sampler	9.9	3.9
Hand-belt sample	9.2	3.8
Difference	0.7	0.1
Second Car		
Car-dumper sampler	9.4	5.4
Hand-belt sample	9.4	5.1
Difference	0	0.3

Table 2 shows the ash, moisture and Btu analysis of the five-car lot check comparing the car-dumper sampler against hand-belt sampling. The size of coal sampled was mine run. The total weight of the car-dumper sample was 540 lb taken in 30 increments, and the total weight of the hand-belt sample was 180 lb also taken in 30 increments.

TABLE 2

	Btu as Received	Ash, Per Cent	Moisture, Per Cent
Car-dumper sampler	12,990	10.9	3.1
Hand-belt sample	12,990	10.5	3.1
Difference	0	0.4	0

Table 3 shows the ash, moisture, and Btu analysis of the sixteen- and thirty-car lot checks comparing the car dumper sampler against the mechanical-belt sampler.

The size of coal sampled during the sixteen-car lot check was 73 per cent mine run and 27 per cent slack by volume. The total weight of the car-dumper sample was 1,728 lb taken in 96 increments. and that of the mechanical-belt sample was 1,280 lb taken in 64 increments.

The size of the coal sampled during the thirty-car lot check was 90 per cent mine run and 10 per cent slack by volume. The total weight of the car-dumper sample was 3,240 lb taken in 180 increments and that of the mechanical-belt sample was 2,400 lb taken in 120 increments.

TABLE 3

	Btu as Received	Ash, Per Cent	Moisture, Per Cent
Sixteen-Car Lot Check			
Car-Dumper sampler	13,025	10.5	3.5
Mechanical-belt sampler	12,980	10.4	3.8
Difference	45	0.1	0.3
Thirty-Car Lot Check			
Car-dumper sampler	12,750	9.6	5.5
Mechanical-belt sampler	12,760	9.6	5.4
Difference	10	0	0.1

Fig. 9—Photograph showing all sampling compartments filled, car almost empty

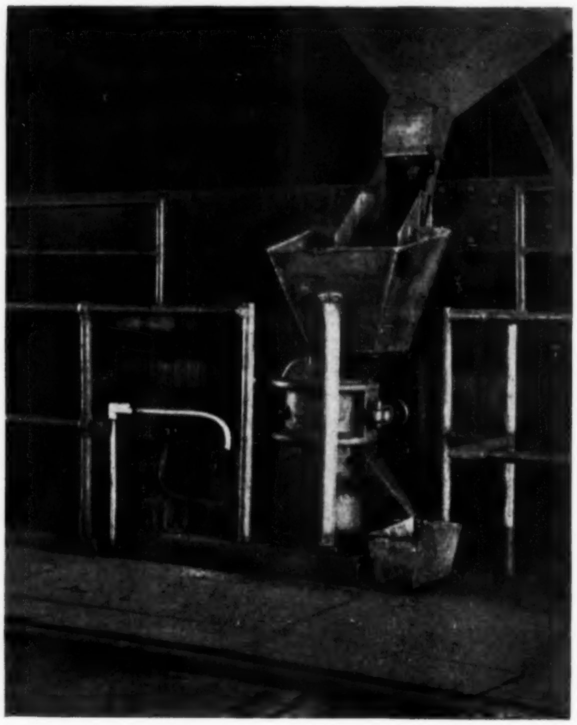

Fig. 10—Grinder installation and lower section of sampler hopper; note size of lumps falling from hopper discharge

The car-dumper sample was crushed by its own mechanical crusher to minus $^1/_4$-in size. The hand- and mechanical-belt samples were also crushed by a mechanical crusher and all samples were reduced to the required laboratory size by ASTM method D492-48. The car-dumper sampler was built under Patent Number 2533090.

The new sampler has the following advantages:

1. Completely mechanized;
2. Rugged, simple, reasonably foolproof;
3. Independent of weather conditions;
4. Devised to take samples from a stream of falling coal;
5. Fast, with a high sampling rate; and
6. Compatible with the present coal-handling system.

Fig. 11—End view showing crusher and sampler hopper

Power Statistics Show Steady Increase in Power Demand

THE latest statistical Federal Power Commission report on production of electric energy and installed generating capacity of electric utilities in the United States, which extends through April 30, 1953, shows a steadily increasing demand. In fact, that for April 1953 was 13 per cent over that of April 1952. For the twelve months ending April 30, 1953, the total output was over 411 billion kilowatt-hours which was not only the highest on record for such a period, but 8 per cent above that for the twelve months ending April 30, 1952. While fuel-generated power increased, water power decreased.

Not only was there a marked increase in central station output but also in electric energy production by power plants of industrial concerns, including the stationary plants of electric railroads. These showed a 12.7 per cent increase.

The combined utility and industrial power output was 41,509,506,000 kw-hr for April 1953 and the combined production for the twelve-month period exceeded 477 billion kilowatt-hours which was 7.4 per cent above that for the like period ending April 30, 1952.

Installed Capacities

Installed capacity of generating plants in electric utility service, as of April 30, 1953, totaled 83,836,361 kw, compared with 76,736,358 kw a year earlier; whereas that of industrial plants is given as 15,375,077 kw. This makes the combined utility and industrial plant capacity in excess of 99 million kilowatts.

Peak loads on the principal electric utility systems totaled 71,948,722 kw in January 1953. While this was below the record maximum of 73,055,403 kw established in December 1952, it was more than 8 per cent over the January 1952 total. Regionally, the highest combined peak occurred in the Northeast, where the energy consumption was also greatest.

Fuel Consumption

The April 1953 coal consumption of the electric utilities amounted to 8,910,232 tons which was the highest April coal consumption on record and a 10.7 per cent increase over that of April 1952. Coal and coal equivalents of other fuels consumed in April 1953 amounted to approximately 13,886,000 tons which was an increase of 20.3 per cent.

Fuel oil consumption amounted to more than 7 million barrels which figure was 70.1 per cent above that consumed in April 1952. This figure, however, was 11.5 per cent under the March consumption.

Natural gas burned by the electric utilities during April of this year was 76,583,679 Mcf, the highest April gas use on record, or a gain of more than 15 per cent over the year previous.

The indicated average April power generation rate, for combustion of coal only, was 1.07 lb per kw-hr.

Stocks of Fuel

Coal stocks on hand at electric utility plants on May 1, 1953, amounted to 40,059,609 tons. This, in terms of days' supply, based on the April rate of consumption, was sufficient to last 135 days at the coal-burning plants.

Fuel oil stocks, as of May 1, totaled 12,231,593 bbl which is estimated as sufficient for 51 days' requirements, based on April use.

Up-to-date figures on the total energy produced by coal and by other fuels are not given, but the latest available full year's figures are those for 1951, which show approximately one-half the total output to have been generated by coal.

Scheduled Additions to Capacity

The foregoing figures are of interest in the light of the Thirteenth Semi-Annual Electric Power Survey of the Edison Electric Institute which was published in May 1953. This deals with some 95 per cent of the capability and 98 per cent of the energy output of power systems in the United States, including both private and publicly owned systems.

This source gives the nameplate rating of new capacity placed in commercial service during 1952 as 6,500,000 kw which included 680,000 kw that had been originally scheduled for operation in 1951, but was not completed till 1952.

However, some three million kilowatts of capacity that had initially been scheduled for operation in 1952 was not in service at the end of that year. Material shortage contributed largely to this slippage.

This three million kilowatts now appears in the 1953 schedule and 1,700,000 kw which was originally included in the 1953 schedule has been moved to 1954. Thus, the present 1953 schedule calls for 11,600,000 kw of new capacity; that for 1954, 11,000,000 kw and that for 1955, 9,400,000 kw. This would mean 32 million kilowatts for the next three years, or a total installed capacity of over 113 million kilowatts by the end of 1955.

However, the Survey Committee expresses some doubt as to whether it will be possible to meet this current program.

Materials Situation

In summarizing the Survey it was stated that the materials situation is far more satisfactory than it has been during the past two years. Although some critical conditions still exist, future prospects are reasonably good. However, this does not mean that delays caused by earlier shortages have been overcome. Much of the time lost because of inadequate material supplies cannot be regained and has caused substantial production setbacks. Delayed deliveries and rescheduling are current evidences of the effects of the past materials situation.

The Technician and the Engineer

By C. J. FREUND

Dean of College of Engineering, University of Detroit

Based on a paper presented before the Technical Institute Division of the American Society for Engineering Education at the University of Florida on June 23, this article clarifies and explains the respective rôles of the technician and the engineer.

THE Detroit Edison Company is building a new 600,000-kilowatt generating station at St. Clair, Michigan. The entire project is in charge of a supervising engineer. Very many engineers either work under this supervising engineer or cooperate with him. These engineers are associated with The Detroit Edison Company, with manufacturers of machinery and equipment, or with contractors who are doing the construction work. These engineers are concerned with the design of buildings, foundations, turbines, generators and the like. Likewise, they make decisions on the ground when problems arise which are not covered by blueprints or specifications.

At the same time, great numbers of technical men on this job are not professional engineers at all. They are technicians. They direct the construction and erection operations, inspect finished work and materials and install and test machinery and apparatus. They are the superintendents, foremen and inspectors.

Overlapping Functions

It is true that the functions and operations of engineers and technicians overlap in practice. But the theoretical line of demarcation is clear enough. Engineers understand the principles and fundamentals of mathematics, physics and chemistry. They use their knowledge in research, design and development. Technicians likewise know mathematics, physics and chemistry. They use their knowledge to perform calculations, to run tests, to make estimates and to prepare diagrams.

Engineers plan; technicians make and do. The engineer creates and projects; the technician operates. The technician is concerned with how to do it; the engineer is concerned with why to do it. It is common for the technician to be more competent in the doing than the engineer. For instance, a land surveyor should be handier with a transit than a civil engineer.

In general, the technician is auxiliary to the engineer. This must be clear if the relation of the technician to the engineer is to be understood. If the auxiliary relation of the technician is not understood and accepted, there is no chance, as I see it, for the proper development of technical institutes. Of course, we have in the United States no fixed occupational classification. Any technician can become an engineer at any time by completing the prescribed training and preparation. It seems to me that the most significant feature in the relation of technicians to engineers is that the vast majority of engineers do not realize the function of the technician, nor do they realize the shortage of technicians. Compared with technicians, the much discussed present shortage of engineers is a trifle.

Consider the typical engineer who has a drawing to make, a test to run, or some other technician task to do. If a real technician is at hand, the engineer gives him the job to do. If no technician is available, he gives the work to a young engineer, or he does it himself. But the engineer should not do a technician's work himself. He should spend his time doing his own proper work. You will never catch a surgeon doing a nurse's work.

It is permissible for the young engineer to perform a certain amount of technician work by way of training and experience. But after he has acquired experience and training, he should not be required to continue technician tasks because no technicians are around. Still more important, he should not spend his whole life doing technician tasks because there are no technicians available.

To inform the engineering profession in the United States is a most important undertaking which confronts technical institutes. The most effective means for doing this is doubtless to tell the story directly to engineers. I should think that technical institute men should appear in the programs of the great national engineering societies. They should publish accounts of their aims, their work and their objectives in the journals of the engineering profession.

*Industrial Turbine Selection**

By J. C. SPAHR†

A review of turbine types that are available for industrial applications, with particular reference to process steam requirements. Typical examples are cited.

INDUSTRIAL turbine users have available turbine equipment to satisfy practically any operating requirements. Types range from the straight condensing unit generating electrical power only to the mixed-pressure, double automatic-extraction units which automatically control speed and process steam pressures at the same time. These turbines, however, can operate satisfactorily only within their designed limits. It is therefore necessary to determine accurately the plant requirements with a reasonable allowance for future expansion before it is possible to make the proper selections. While each engineer has his own particular problems there are several major objectives which should guide the selection in all plants. First of these is the generation of process steam and electrical power at minimum cost; second, is an installation which will permit maximum freedom to obtain process steam and electrical power as desired; and third, dependable operation.

It is an accepted fact that when both process steam and electrical power are required, the most economical operation is obtained when the by-product power is at a maximum. The important point is to have a thorough knowledge of the plant requirements as a basis for selecting turbine equipment that will give maximum by-product power.

Steam and Power Demands

Plant studies should result in process steam demand charts similar to that shown by Fig. 1. In this instance process steam is required at both 90 and 15 psi. Electrical load demand for the same period is shown by the full line on Fig. 2. For these examples the inlet steam conditions were established at 400 psi with 175 deg F of superheat. With inlet steam conditions, process steam flows and process steam pressure known, the electrical power developed from process steam can be determined. The load developed depends on the steam flow, available energy, and the efficiency of the unit. Fig. 3 shows the approximate efficiency of both condensing and noncondensing turbine-generators from 500 to 7500-kw ratings. Final performance on the turbine selected must be obtained from the manufacturer. By choosing a rating at random for efficiency on the first trial all the factors are known for calculating the electrical load developed.

The available energy is obtained from the steam tables or steam charts, from which it is found that the enthalpy drops from inlet to the process steam pressures in the above case are 133 Btu to the 90-psi point and 228 Btu to the 15-psi pressure. Assuming a 2500-kw noncondensing unit for the first trial, the efficiency is found to be 0.713. Therefore $133 \times 0.713 = 95$ Btu per lb is converted into work for 90-lb steam and $228 \times 0.713 = 162.7$ Btu per lb is converted into work for 15-lb steam.

Since 3413 Btu are equivalent to one kilowatt-hour the pounds of steam per kilowatt-hour are: $3413/95 = 35.9$ lb for 90-psi steam, and $3413/162.7 = 21$ lb for 15-psi steam. Knowing the steam rate in pounds per kilowatt-hour, the by-product power can be determined and plotted against load demand, as shown in Fig. 2.

It will be noted that at no time during the year does the by-product power balance the electrical load demand.

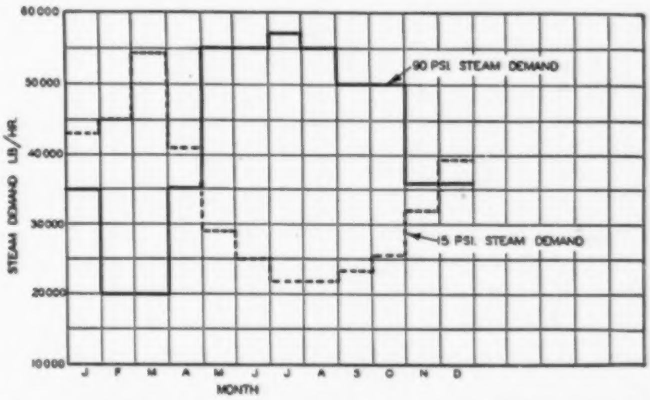

Fig. 1—Combined process steam demand to be supplied from turbine

This is the usual situation and for a satisfactory installation a source of firm power must be provided to supply the difference between load demand and by-product power. The source of firm power depends on whether the plant has a tie-line available to a public utility or whether it is entirely independent, in which case the firm power is produced by straight condensing or automatic extraction units. Many plants find it advantageous to provide both sources of firm power using the tie-line for the most part as a standby.

Generator-Drive Turbines

A commonly used combination consists of a straight noncondensing unit and a condensing single or double automatic-extraction unit. Figs. 4 and 5 are sections, respectively, through a typical noncondensing unit and a condensing single-extraction unit.

The majority of turbine-generator units installed in the oil refineries since 1946 have been designed for 600 psi inlet pressure or higher. This is a natural trend since larger blocks of by-product power are produced by the same quantity of steam flow. However, opportunities for obtaining by-product power, as well as a balance between steam and power, from the existing steam plant should not be overlooked.

* Excerpts from a paper presented at the AIEE Summer General Meeting at Atlantic City, N. J., June 15-19, 1953.
† Assistant Manager, Industrial Turbine Engineering, Steam Division, Westinghouse Electric Corp., Philadelphia, Pa.

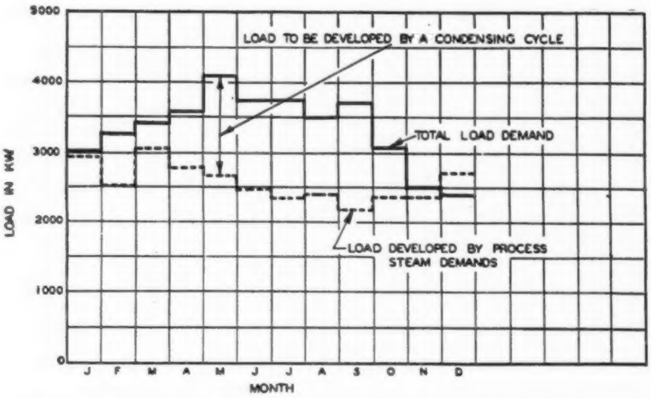

Fig. 2—Power load-demand curve showing division between process steam and condensing cycle

A plant expansion now in progress includes three units, each with a 12,500-kw capability, designed for 680 psi, 688 F inlet steam and 200 psi exhaust pressure. This by-product power is produced by a process steam flow of 490,000 lb per hr from each unit.

General Purpose Turbines

When making plant studies the general purpose mechanical-drive turbines must be included in the overall heat balance for the most economical plant operation. The oil industry with its numerous applications for pumps, fans and compressors offers many opportunities for generating by-product power.

Mechanical drive turbines have been built for pressures up to 1500 psi, for steam temperatures up to 1,000 F, speeds in excess 10,000 rpm and ratings up to 30,000 hp. The relative ease with which they can be arranged for variable speed operation makes them particularly desirable for driving variable-speed apparatus. Several types of control are available and each in its proper application can readily satisfy the needs of the driven apparatus.

Fig. 6 is a section through a 588-hp, 3680-rpm boiler-feed-pump drive designed for 680 psi, 688 F inlet steam and exhausting at 200 psi. Two such units are being installed in the same plant as the three 12,500-kw units mentioned above and operate on the same steam conditions. A 7500-hp unit for compressor drive is shown in Fig. 7.

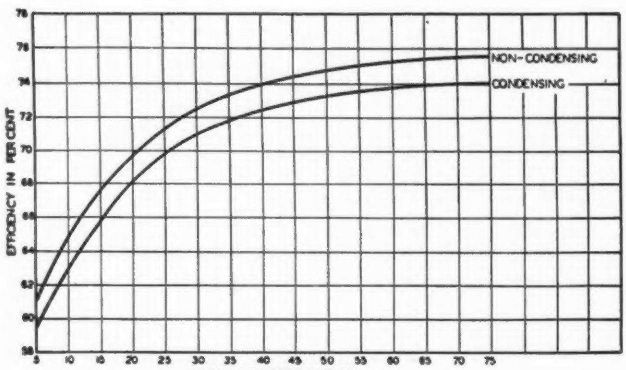

Fig. 3—Approximate rankine cycle efficiency ratios of turbine-generators

Regenerative Feedwater Heating

Turbine-generator ratings for most industrial units fall within the range of 1500 to 10,000 kw. Steam requirements for these units, however, are in many cases equivalent to those required for many central stations. Practically every large steam-turbine installation operates with regenerative feedwater heating. Fig. 8 shows a typical industrial plant layout where the feed heating facilities have recently been expanded to include the high-pressure heater. The plant utilizes something over 200,000 lb of steam per hour which compares with the flows required for a conventional 20,000-kw straight condensing unit. Such a condensing unit would in all probability be provided with at least three stages of feedwater heating.

Based on operating steam conditions of 400 psi, 750 F total temperature, and $1^1/_2$ in. of mercury absolute back pressure, the improvement in heat consumption for a straight condensing turbine can be obtained from Fig. 9. For other types of units, such as automatic extraction, the savings will generally differ from those on the curve and the actual savings must be calculated. Steam temperature has only a small influence on the gains obtained by stage heating.

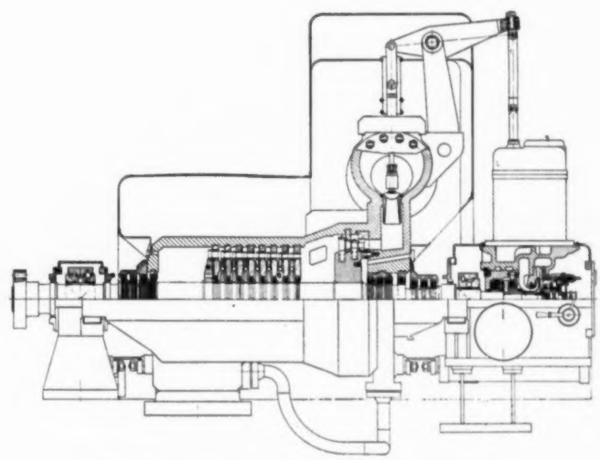

Fig. 4—7500-kw noncondensing turbine

Fig. 9 shows that for all practical purposes the maximum reduction in heat consumption for three-stage heating is obtained for total rise in feedwater temperatures from 220 up to 270 deg F.

Large Capacity Installations

As mentioned previously, industrial turbine-generator units generally range in ratings from 1500 to 10,000 kw. However in some larger plants power requirements are often high, and require units of high ratings. Fig. 10 shows the plant arrangement of an installation including three straight noncondensing turbine-generator units each with a capability of 18,750 kw, as well as various mechanical drive turbines and the feedwater heaters, which was placed in service in 1930 for the supplying process steam at approximately 150 psi to an oil refinery. The mechanical drives, except for the boiler feed pump, exhaust to the deaerating heater at 3 to 13 psi depending on plant load. The boiler feed pump turbine exhausts

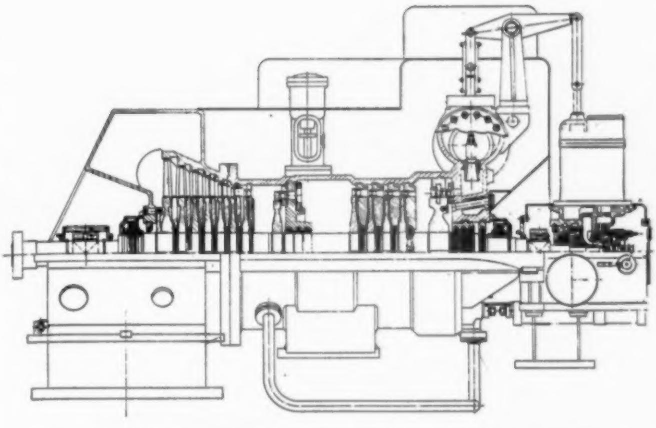

Fig. 5—6000-kw condensing single-extraction turbine

to the jet condensers. The high-pressure heater taking steam directly from the low-pressure header heats the boiler feedwater to 365 F. Balance between steam and electrical power is maintained by a tie-line to a public utility.

In 1938 additional capacity was added with the installation of two condensing automatic extraction units. The high-pressure section of the turbine from inlet to extraction opening was designed for the same conditions as the original noncondensing units. Each turbine is capable of developing 15,000 kw on extracted steam. At the time of this installation it was recognized that additional firm power would be required in the system. This requirement was met by the condensing end of the extraction machine which is capable of developing an additional

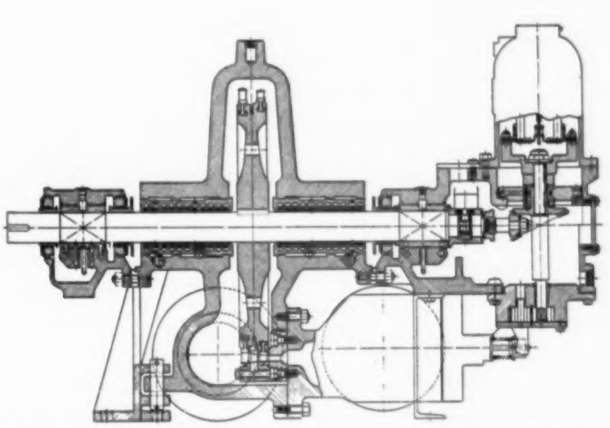

Fig. 6—Noncondensing turbine-boiler feed pump drive

10,000 kw. When the unit is operated with the maximum design flow to the condenser and the remaining portion of the maximum throttle flow extracted for process the unit is capable of developing 25,000 kw. A third unit of this design was installed in 1943.

In recent years additional straight condensing units have been added to the system, also the demand for 150-psi steam has increased so that these units are now operated with maximum extraction continuously. In fact the steam demands have now outgrown the existing equipment and two new noncondensing units, each of 50,000 kw capability, and a maximum steam flow of 810,000 lb per hr are scheduled for operation early in 1954.

The process steam flow required from each of these two units is approximately 50 per cent greater than that from each of the original noncondensing units. The resultant electrical output, however, is approximately $2^1/_2$ times the original unit. The increase in power is the result of increased available energy in the steam. Since the exhaust pressure is fixed, the increased available energy is obtained by raising the inlet conditions. In raising the inlet conditions, however, it must be kept in mind that the exhaust temperature must be approximately the same as that on the other units in the plant. It is therefore necessary to select a combination of inlet pressure and temperatures which will give the proper available energy and at the same time the proper exhaust temperature. Inlet steam conditions of 1450 psi, 950 F and 150 psi exhaust pressure meet these requirements.

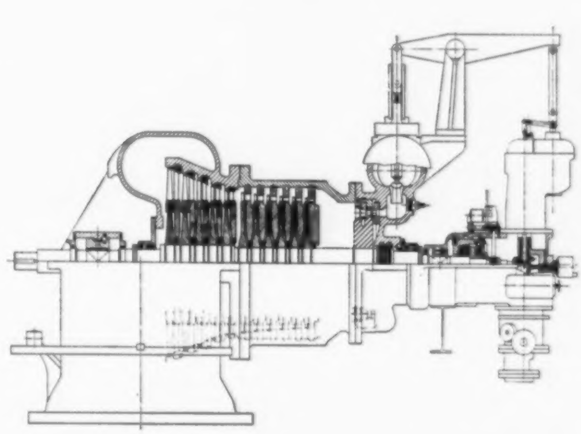

Fig. 7—7500-hp condensing turbine-compressor drive

Turbines arranged to furnish steam to process at one controlled pressure were first employed in industrial plants prior to 1915, whereas those designed for two controlled pressures were first used in the 1920's. Recently turbine-generator units designed to control steam flow to process at three controlled pressures have been placed in operation. Fig. 11 shows a 30,000-kw turbine which was placed in service several years ago, controlling flow to process from two extraction openings, as well as flow from the exhaust under controlled pressure. A duplicate unit is now being erected. As the number of pressure controlled process points increase, the scope of application rapidly decreases.

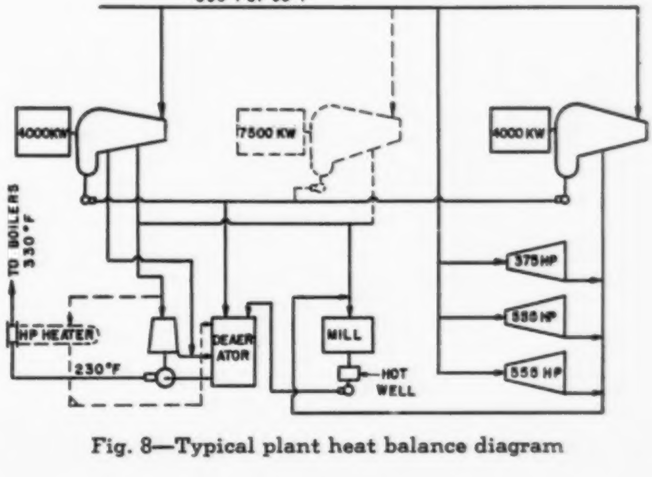

Fig. 8—Typical plant heat balance diagram

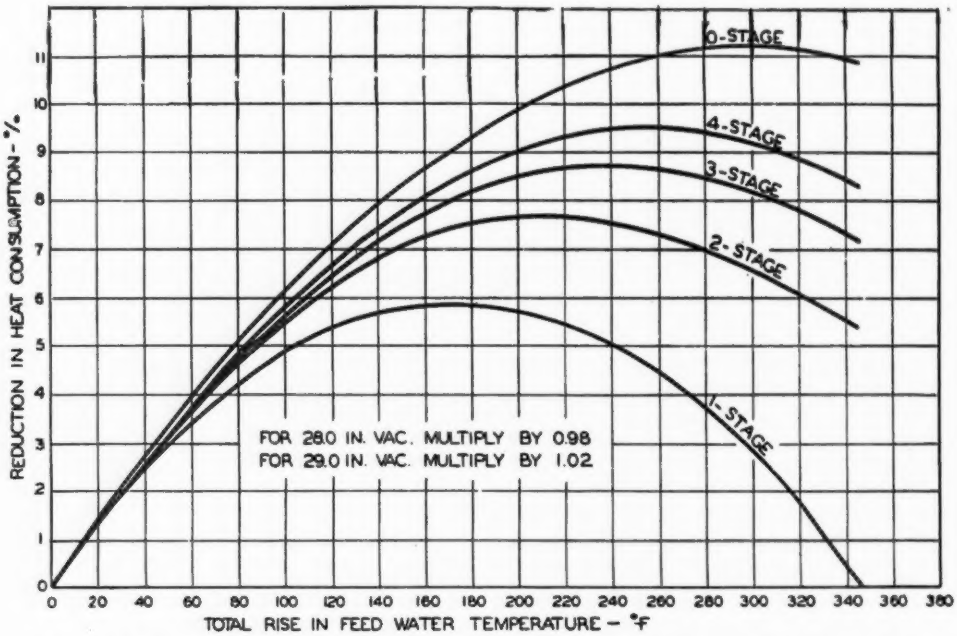

Fig. 9—Reduction in heat consumption by regenerative feedwater heating. Full load steam conditions 400 psig, 750 F, 28.5 in. Hg

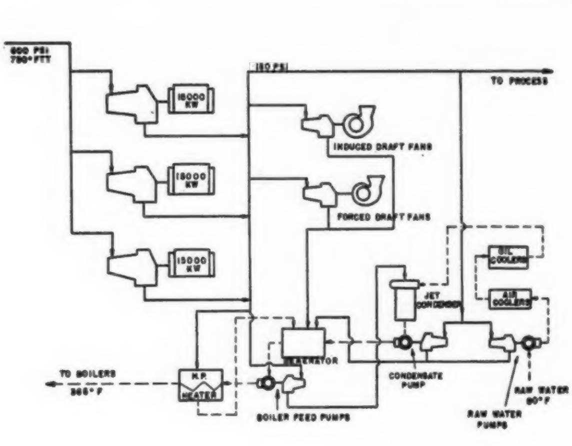

Fig. 10—Arrangement of large power plant

Conclusion

The foregoing discussion illustrates that there is as large a variety of turbine drives available for industrial application as there are opportunities of utilizing the process steam to generate power. As the fuel costs increase it is more important than ever to select the right turbine for the job. This can be done if the turbine is selected on the basis of a thorough knowledge of plant requirements. Plant analysis similar to that illustrated is of utmost importance in obtaining a successful turbine installation. With turbines available in all sizes and types from the single-wheel mechanical drive to the large turbine-generator units and for any steam pressure and temperature up to present-day limits industry has every opportunity to select turbine equipment to match plant requirements.

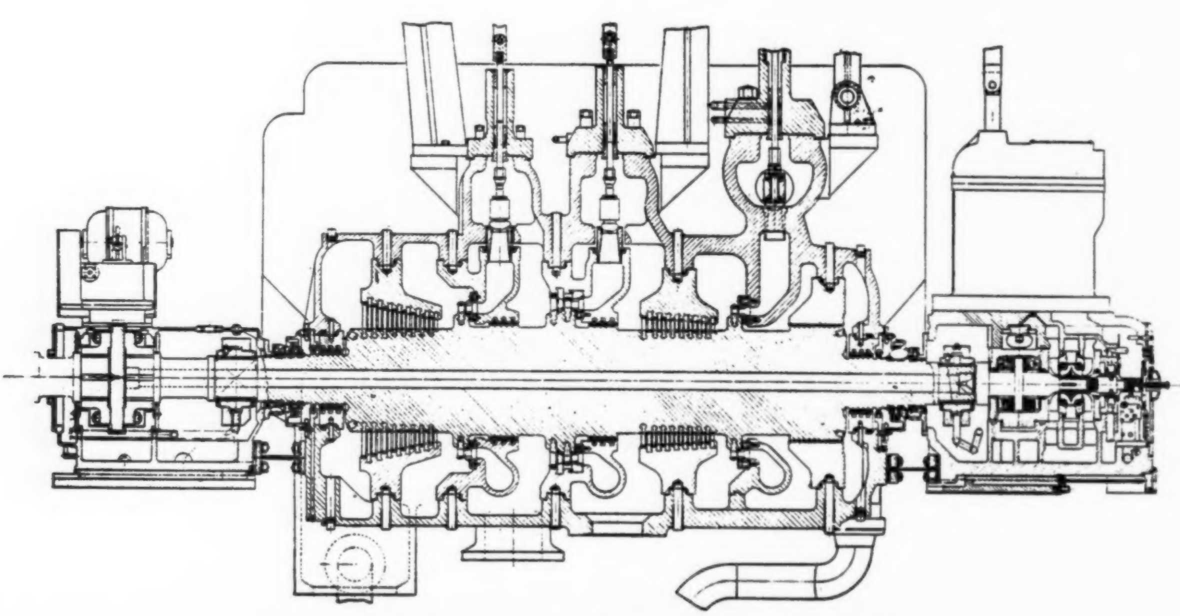

Fig. 11—30,000-kw noncondensing double-extraction turbine

Facts and Figures

Iron, in one form or another, is present in most of our natural waters.

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It is estimated by Bituminous Coal Institute that the total tonnage of coal mined in the United States in the last 150 years is equivalent to about $2^1/_2$ per cent of present known recoverable coal reserves.

•

Silicone rubber retains its rubberlike properties at temperatures far above and below the limits of organic rubber.

•

Experience abroad has shown that loss of power, due to deposits of fuel-oil ash on the blades of gas turbines, limits the use of boiler oil in turbines of the open-cycle type.

•

Judging from present research and developments in the field of nuclear energy, the liquid-metal-cooled reactor appears attractive as a power producer, particularly where high steam pressures and temperatures are involved.

•

Coal burned in the generation of electricity for New York City is consumed at the rate of a train-load every six hours, or more than 280 carloads every 24 hours.

•

Temperatures within an oxy-acetylene flame are some two thousand degrees higher than those in a pulverized coal flame.

•

The per capita use of electricity in the United States is approximately two and a half times that in Great Britain.

•

During the last fifteen years the proved reserves of crude oil in the United States have more than doubled.

•

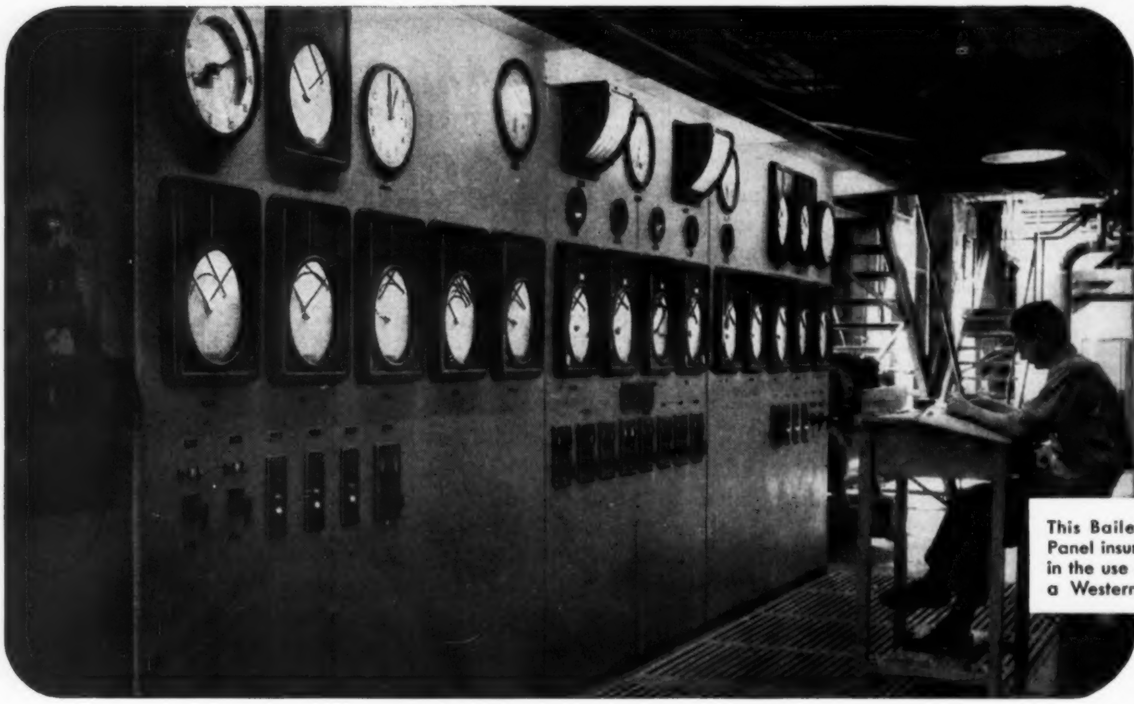
Radioactive isotopes are now being employed extensively in metallurgy to study diffusion in solids, oxidation, corrosion and the distribution of impurities in alloying elements.

•

Where employment of chlorination treatment of condensing water is indicated to combat algae, practice appears divided between use of sodium hypochlorite, calcium hypochlorite and liquid chlorine.

•

According to a cost survey recently conducted by *Electric World*, new central stations completed in 1952, with a few exceptions, ranged in cost from \$90 to \$165 per kilowatt, despite ever-rising material and labor costs. This reflects the economy of large units, single boiler-turbine layout, semi-outdoor construction and many design refinements.



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment — fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell — or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better fuel-dollar efficiency — for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METER COMPANY

1025 IVANHOE ROAD
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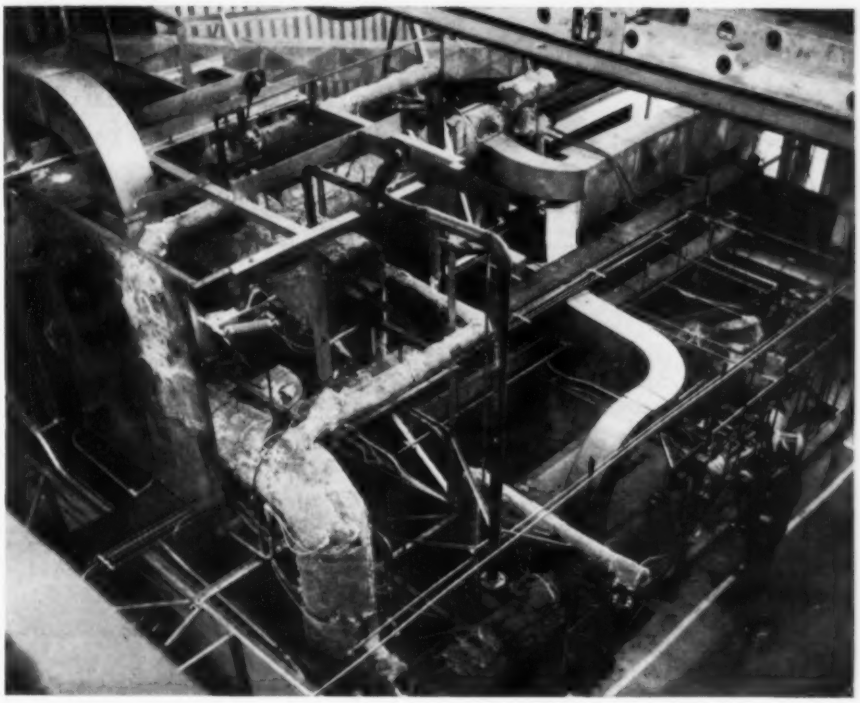
Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

Liquid Sodium Installation

Liquid sodium is pumped and metered electromagnetically in an experimental installation at the Knolls Atomic Power Laboratory operated by the General Electric Co. in Schenectady, N. Y., for the Atomic Energy Comission.

The closed circuit loop was devised to study electromagnetic pump and magnetic flowmeter operation and obtain performance curves by computing pressure versus flow, using voltage, pressure and sodium temperature variants. Flow is measured by the magnetic flowmeter in gallons per minute with an accuracy within two per cent. Temperatures vary according to tests performed and range from 580 to 1000 F. The pump and flowmeter, developed for installations such as this one, operate on magnetic principles and have no moving parts.



Experimental setup for liquid sodium tests

Establishes Nuclear Power Division

Combustion Engineering, Inc., has established a Nuclear Power Division, headed by David M. Schoenfeld who will report to W. H. Armacost, vice president in charge of engineering. Mr. Schoenfeld, an executive of the company's engineering department for some years past, has been in charge of engineering relative to controlled circulation boilers and marine boilers, as well as of special development in these and other fields.

This step, according to M. H. Isenberg, president of the company, was taken primarily to give separate identity to an activity in which the company has been engaged for some time and to facilitate its expansion. The company is presently occupied with several projects having to do with the development of equipment for nuclear power generation, including the supply of major components for an atomic-powered submarine. It is also making studies and conducting development work having to do with some of the practical problems of design, fabrication, metallurgy, etc. involved in utilizing the heat generated in nuclear reactors for the production of power. It has been working in close cooperation with several industrial and utility groups and with governmental agencies engaged in atomic activities.

Titanium Supply Assured

The Defnese Materials Procurement Agency has announced that it has contracted with Cramet Inc. of Chicago, a subsidiary of Crane Co., for production of 30,000 tons of titanium sponge over a period of five years. This is almost pure raw material from which the titanium metal is produced. The contract calls for construction of a 25 million dollar plant.

DMPA has similar contracts with Titanium Metals Corp. and with du Pont. The former calls for 18,000 tons over five years and the latter for 13,500 tons over the same period. Thus, the U. S. Government will have available by 1956 a total yearly supply of about 13,200 tons.

Largest Rolling Mill Handles Heavy Boiler Plate

A 206-in. rolling mill at Lukens Steel Company, Coatesville, Pa., known as the "Big Mill" throughout the steel industry, is said to be the largest rolling mill in America. It is capable of producing steel plate (carbon steel, alloy steel, clad steel or non-ferrous plates) up to 195 in. wide and thus lessens the number of fabricating operations in the construction of certain types of vessels.

The photograph, left, which shows the shell of a large high-pressure boiler drum, was rolled on this mill. The finished plate measured 459 in. by 119 in., was $6^3/_{16}$ in. thick and weighed 96,000 lb.

Boiler drum of $6^3/_{16}$-in. plate

*Graduate Education in Engineering**

By WILLIAM BOLLAY†

The study of engineering science versus physics in preparation for an engineering career is discussed, and it is urged that both graduate and undergraduate instruction be devoted to the basic engineering sciences, with specialized subjects deferred until the individual has engaged in practice. It is further suggested that the top quarter of a class be encouraged to undertake graduate studies.

THE question of what type of graduate education is of most benefit to an engineer may be approached by reviewing briefly the history of engineering during the past twenty years. It has been my own experience during this time that the only engineering courses which have been of any use to me have been those dealing with the basic engineering sciences. Everything we learned in highly specialized courses in various phases of engineering has been rapidly obsoleted by new developments. In aeronautics, for example, the biplane truss design has been replaced by monococque wing design; the reciprocating engine has been replaced by the gas turbine; the wooden structures have been replaced by dural, steel, titanium and glass cloth laminates; the manual controls have been replaced by hydraulic, electric or pneumatic servos and gyroscopic autopilots. Thus, primary emphasis in graduate, as well as undergraduate, education in engineering should be devoted to teaching the engineering sciences, thoroughly and clearly, illustrating the principles by application to modern engineering systems, demonstrating the principles with simple laboratory models, and giving the student practice by realistic design problems.

Specialized Study

Since the time available in postgraduate education is limited to, at the most two or three years, time devoted to highly specialized and applied courses should be restricted to a minimum. These specialized subjects should be preferably taken as extension division courses after the student is engaged in engineering practice and has a need for specialized knowledge dealing with his type of work. It is my belief that the detailed design tricks can best be learned by an engineer after he is engaged in a given field, and that the so-called "art of engineering" or the design of a complicated engineering system cannot be taught in the limited time available in school without slighting the essential engineering sciences. This "art of engineering" would therefore be acquired as the result of engineering practice by building upon a sound foundation of the engineering sciences.

Engineering Science vs. Physics as Preparation for Engineering

It has been argued by some educators that the best graduate preparation for a career in engineering is graduate study in physics, chemistry and mathematics. It is my impression that an outstanding young physicist can learn to tackle engineering problems just as an outstanding young engineer can learn to solve problems in physics. However, there is a considerable difference in emphasis between the engineer and the physicist, or the mathematician, in his outlook and his approach to a given subject.

One may approximately summarize this situation by stating that the standard physics courses and texts concentrate on developing the fundamental principles of physics and stating them in a simple mathematical form, that the engineering science courses and texts concentrate on the applications of these principles and equations to engineering problems. Thus, to the physicist, elegant methods of deriving and summarizing the equations are of considerable importance. To the engineer the principle problem is to reduce a very complicated physical situation to a simplified model, which he can think through and understand with the aid of the mathematical equations and which he can analyze with the aid of simple approximations and digital or analog computers, or with the aid of model tests and experiments. Obviously, there is a considerable region of common interests. It is my belief, however, that courses in physics are not a substitute for the related courses in the engineering sciences but rather, a supplement and that therefore, the engineering sciences should be taught as such by "engineering scientists" who know the practical problems of engineering as well as the applicable basic sciences.

The graduate student working toward a PhD should learn the methods and techniques of engineering research in preparing his thesis under the supervision of an experienced faculty advisor. It is very desirable that the thesis include experience with both the analytical and experimental methods of engineering research. In addition, the graduate students should obtain experience in presenting the results of his research work orally before an audience in a weekly research conference and at least once a year, by presenting a seminar. Such practice in public speaking on engineering topics, if criticized constructively by the audience, is of much more help to an engineer in learning to express his ideas than the formal courses in public speaking.

Extension Division and Specialized Courses

Most engineers cannot anticipate the exact field of engineering in which they will be active after they leave the university and therefore, it is recommended that highly specialized subjects generally be studied by the engineer after he is engaged in his professional practice. This may be done either with the aid of textbooks or extension division courses at a neighboring university. Thus a mechanical engineer who is engaged in the design of gas turbines would do well to supplement his basic engineering science studies with a course in jet propulsion or in turbo-machinery. A course in jet propulsion would include the basic theory of steady and nonsteady flow jet propulsion systems in air as well as in water. A course in turbo-machinery would include a survey of the theoretical methods and the experimental data available for the design of axial flow compressors and turbines, radial flow compressors and turbines, etc. If he is engaged in the design of combustion chambers for gas turbines, it would be to his advantage to take extension division courses in the theory of flames and combustion including a summary of the aerodynamic as well as the chemical aspects of this problem. If he is engaged in the design of regulators and controls for gas turbines, the mechanical engineer would do well to take extension division courses in servomechanisms and automatic control systems. If he has had a good program

* Excerpts from a Presentation before the ASME Semi-Annual Meeting at Los Angeles, June 28–July 2, 1953

† President and Technical Director, Aerophysics Development Corp. and Visiting Professor, Department of Engineering, University of California at Los Angeles.

of courses in the engineering sciences, it is very simple for him to assimilate the subject matter of these specialized courses rapidly and to be in a position where he can make new contributions based upon his knowledge of the fundamentals.

The instructors for these extension division courses should ordinarily be outstanding engineers engaged in the practice of engineering. They will know much more about these advanced fields of engineering than any instructor at the university could be expected to know unless the latter is devoting a considerable portion of his time to research or to professional consultation with an engineering group active in this field. It is generally impossible for any instructor at a university to keep up to date in the details of various new fields of engineering development and consequently, the device of utilizing practicing engineers to teach these subjects is almost the only practical method for rapidly introducing these subjects into a university curriculum.

Extension division courses taught by professional engineers offer at the same time, an excellent opportunity for the professor teaching a related engineering science to be kept informed of new technical developments and to introduce problems, demonstrations and new developments from these extension division courses into his own courses in the basic engineering sciences and to keep the basic engineering science courses lively and interesting.

Improvement in Engineering Instruction

The success of an engineering school in developing outstanding graduates depends primarily upon three factors: (1) Excellent physical facilities including buildings, laboratories, and research equipment; (2) a faculty composed of outstanding engineers with competence in both teaching and the practice of engineering; (3) a capable group of students selected for their qualifications for engineering. The order of importance is in the reverse order to that listed. These conclusions also apply to graduate education in engineering.

In order to improve the caliber of the graduate students, it is suggested that the most qualified BS graduates in engineering be encouraged to continue graduate studies in the engineering sciences. It is suggested that engineers within the upper quarter of their graduating class continue for one or two years of graduate study toward a Master's or Professional Engineering degree; that the top ten per cent be encouraged to continue their studies toward a PhD degree. It is recommended that most of these graduate studies be concentrated on the engineering sciences, and that the student usu-

ally defer highly specialized courses until after graduation.

It is recommended that the graduate faculty of engineering be selected from among the top one per cent of engineers in competence and with at least ten years of engineering experience. It is also recommended that the salary for these members of the engineering faculty be comparable with that paid to the top one per cent of the engineering profession. In order to maintain their technical competence, it should be expected that this graduate staff devote about twenty per cent of their time to engineering research or engineering practice. Thus, they should be paid by the university for instruction at a rate corresponding to eighty per cent of the full time salary of the top one per cent of professional engineers; the remaining twenty per cent of their salary might come from research or engineering practice sponsored by the university or outside industry.

It is recommended that the instructors in the specialized courses taught in the extension division be selected from among the best professional engineers engaged in industry in the particular subject. These instructors would normally devote about eighty per cent of their time to engineering practice and twenty per cent to teaching. In this manner, the most advanced fields of engineering development would be presented at the university by the real experts without making it necessary for the university to establish large associated development projects in every branch of engineering.

By this dual approach of having the basic engineering faculty devote about twenty per cent of their time to engineering research and development and conversely having outstanding practicing engineers devote about twenty per cent of their time to teaching specialized subjects in engineering, it would be possible to bridge more effectively the gap between the engineering school and the engineering profession.

Alberta Oil and Gas

The Province of Alberta, Canada, has just issued a review of operations in its oil and natural gas fields for the year 1952. New production records were set during the year with a total crude oil output of approximately 59 million barrels from over 3300 active wells, and more than 95 billion cubic feet of natural gas. The estimated oil reserves of the province are about 1 1/2 billion barrels. It is believed that the rate of expansion will soon enable Canada not only to be practically self-sufficient in meeting its oil and gas requirements but also be able to sustain considerable exports from certain fields.

Although oil has been produced in limited amount in Canada for many years, growth of the industry in Alberta has been spectacular since 1947. Not only has the total output soared, but proved reserves have increased twenty-five times, production potential fifteen times, land under development ten times and exploration expenditures twenty-five times. Discovery of several of the more important fields has been made since 1947.

The three largest fields are Redwater, estimated to contain up to 750 million barrels, Leduc-Woodbend with more than 275 million barrels and Wizard Lake of 100 million barrels. The oil occurs largely in layers of Devonian limestone at depths of 5000 to 10,000 feet.

Prior to the discovery of the Leduc and Redwater oil fields in 1947, Alberta was scarely producing enough oil to meet her own needs and many other sections of Canada were importing crude oil for refinery stock, also refinery products. However, since the Alberta discoveries were not adjacent to major oil markets, pipeline construction became necessary. One such line now extends over 1100 miles from Edmonton to the head of the Great Lakes at Superior, Wis., with various branches.

All Canada shares in the economic benefits of Alberta oil, inasmuch as replacement of American oil imports by domestic oil production has enabled large savings in American dollars and helped to raise the value of the Canadian dollar.

The greatest output of natural gas in the province was from the Turner Valley fields which produced about a third of the total. Other large producers were the Viking-Kinsella and the Leduc-Woodbend, the latter also a large oil producer.

Some 250 miles northeast of Edmonton is located a group of gas fields that comprise the Peace River area which straddles the Alberta-British Columbia border. Here there are vast recoverable gas reserves.

(*Continued on page 66*)

About a year ago the Alberta government gave permission to Westcoast Transmission Ltd. to export natural gas from these Alberta fields in this region and similar permission was granted by the Canadian government; but the company is now awaiting authorization from the U. S. Federal Power Commission to import the gas coming by pipeline from a point three miles from the Alberta-British Columbia border, through the interior of British Columbia, to a point near the international boundary about six miles from Sumas, Wash. From here a branch line would extend to Vancouver, B. C. and the main line would continue south to the United States.

Although heavy industries and a large consumer population in the provinces of Ontario and Quebec provide the largest potential market for Alberta natural gas, the government has not yet permitted the export of gas to these eastern markets. This is despite proposals by least two companies one of which would construct lines to Toronto and Montreal, and the other through Saskatchewan and Manitoba to Minnesota.

Combustion Engineering-Sulzer Bros. Ltd. Agreement Anticipates 5000-Psi Boilers

Combustion Engineering, Inc. has just announced the consummation of an agreement with Sulzer Bros. Ltd. of Winterthur, Switzerland, well-known European manufacturer of steam-generating and related equipment, for the use of Sulzer patents, designs and experience.

This agreement, it is stated, represents the culmination of several years' investigation by Combustion of European developments in the field of high steam pressures, and of such research and development work as might have application to the problems of generating steam at above-critical pressures. The investigation revealed that the many successful installations of "Sulzer Monotube Steam Generating Plants" had demonstrated not only the practicability and efficiency of the design but also that it possessed special adaptability to the use of pressures above the critical. The investigation also disclosed that Sulzer's research as well as its specialized experience with the once-through type of unit could contribute importantly to the studies Combustion has been making for some time past of the problems involved in generating steam at pressures of 5000 psi and higher.

The agreement also includes provision for the use of Sulzer patents, developments and experience with re-

spect to controls for high-pressure steam generators. The work done by Sulzer in this field is believed to be especially applicable to the control problems anticipated in generating steam at presssures above critical.

The combination of the long experience of Combustion and Sulzer is expected to contribute generally to the advancement of the art of high-pressure steam generation and to expedite the development of designs for installations in the 5000-pound pressure area.

New Method of Cleaning Coal-Washery Slurries

A new method of cleaning and dewatering coal-washery slurries to recover a clean coal product that can be coked or made into briquets has been developed by German scientists. The method is described in a recent Bureau of Mines information circular.

Washery slurry is a pasty mixture of fine coal, impurities and water obtained in washing coarser sizes of coal.

The method, called the "Convertol Process," was developed by the research staff of Deutsche-Kohlenbergbau-Leitung, the coal producers' association of western Germany, and consists of two steps. First, small quantities of heavy oil are mixed with the slurry. The oil coats the tiny particles of coal, which in the second step are separated from the dirt and water in a centrifuge. The water and dirt pass through screen perforations in the centrifuge, while the oiled coal particles are retained and later discharged as a clean, low-moisture product.

Obituary

Cyril G. R. Humphreys, an engineer in the Research Department of Combustion Engineering, Inc., died on July 19 following a long illness. Born in London in 1905, he received his educational training in England. He was employed in research work by The Consolidated Edison Co. of New York from 1930 to 1942, at which time he joined Combustion Engineering Co. The author of a number of technical papers on methods of furnace-temperature measurements, he was also keenly interested in engineering history and wrote a notable series of articles on developments in pulverized coal firing which appeared in this publication in 1948. He was a member of the American Society of Mechanical Engineers, the Institution of Mechanical Engineers (England) and the Newcomen Society. He is survived by his wife and two children.

Hot-Process Softening

In a paper entitled "Zeolite Vs. Soda Ash in Hot-Process Softener at Firestone,", which was presented at the ASME summer meeting in Los Angeles, **W. F. Fields,** of Firestone Tire & Rubber Co., cited the following anticipated advantages of hot styrene-base zeolite secondary softeners:

1. A lower total hardness in addition to lower magnesium hardness could be obtained consistently regardless of raw water or feeding variations. Lower phosphate dosages would be required and the amount of sludge in the boilers would be reduced.
2. A lower carbonate alkalinity in the feedwater could be obtained by eliminating the need of excess soda ash in the first-stage treatment. The CO_2 formation in the steam produced would be correspondingly lower, thereby reducing corrosion in the return-line systems.
3. In instances in which the water contains an appreciable amount of noncarbonate hardness, soda-ash addition could be completely eliminated, thereby making a saving in operating cost.

In December 1951 a zeolite water-softening system was installed at the Los Angeles plant of Firestone. Inspection of the evaporators and several of the feedwater units, after operation for about six months showed that the system, which previously had been heavily encrusted with calcium carbonate scale, was almost clean.

Chemical costs for the hot lime-zeolite softeners proved to be \$8.75 a day cheaper than with the original hot lime-soda softeners, based on makeup of 379,000 gal per day. Feedwater effluent has been improved, feed lines are being descaled, and it has been found possible to reduce the blowdown.

REVIEW OF NEW BOOKS

Any of the books here reviewed may be secured through Combustion Publishing Company, Inc., 200 Madison Ave., N.Y.

Power Plant Engineering

By Frederick T. Morse

Subtitled "The Theory and Practice of Stationary Electric Generating Plants," the drastically revised Third Edition of this well-known text attempts to meet the needs of the engineering student, the consulting engineer and the plant operator. Emphasis is placed upon the power plant as an integrated assembly, and there is more attention given to the small plant than was the case in previous editions. The author provides the following basic definition.

"Power plant engineering is the art of selecting and placing the necessary power-generating equipment so that a maximum of return will result from a minimum of expenditure over the working life of the plant; and the operation of the completed plant in a manner to provide cheap, reliable and continuous service."

An introductory chapter provides background information on thermodynamics and gives a description of the function of consulting engineers in power plant design. Subsequent chapters take up the variable load problem and power plant economics, including depreciation methods and an introduction to rate making. Following this general presentation are chapters on the power plant building, fuels and combustion, internal-combustion-engine and gas-turbine power plants, vapor cycles and energy flow, steam generators and prime movers, gas and feedwater loops in steam plants, piping systems and instrumentation. At the end of most chapters is a set of problems without answers. A brief bibliography and an appendix conclude the work.

This 687-page text is extremely well organized and contains much useful information both for the student and the practicing engineer. It sells for $8.75.

Textbook of the Materials of Engineering

By Herbert F. Moore and Mark B. Moore

Now in its eighth edition, this text provides a broad survey of the field of engineering materials. When the first edition was published in 1917, its objective was to furnish a concise presentation of the physical properties of the common materials used in structures and machines, together with brief descriptions of their manufacture and fabrication. Over the intervening years, this objective has been maintained, so that the present edition includes consideration of many materials and techniques which were unknown at the time of initial publication.

The coverage of the properties of materials includes methods of production and chemical and mechanical methods of strengthening materials. Among the introductory chapters are considerations of elastic strength, failure by creep and fracture, allowable working stress, and physical properties of typical structural metals. Later chapters are concerned with such materials as wood, building stone and ceramics, concrete, plastics, rubber, leather and rope. A particularly interesting chapter takes up materials specifications writing and the activities of the American Society for Testing Materials.

Comprising 372 pages and selling for $6, this book has worth both as a text and as a reference work for the practicing engineer.

Diesel Engineering Handbook Eighth Edition

Revised by A. B. Newell

Originally written in 1935 by the late Lacey H. Morrison, this book early gained acceptance as an authoritative source of information on diesel practice. Periodic revisions, first by the original author and later by Charles Foell, served to keep the reader abreast of significant developments in this rapidly expanding field.

This book of 827 pages starts with a brief review of the fundamental principles of the diesel engine and carries the reader through various phases of design and construction. Mathematics is subordinated to practical explanations.

Stationary, marine, railway and automotive types are covered and the principal makes described. Considerable space is devoted to such subjects as fuel injection pumps and systems, lubrication, engine cooling, governing, etc., and a chapter on "Efficiencies and Economics" is most informative. There is a final chapter, published for the first time in this book, containing data on the specifications of American-built diesels.

The text is profusely illustrated and is priced at $7.50 in the U. S. A. or $8.50 in other countries.

Adventures in the Navy, Education, Science, Engineering and War

By W. F. Durand

This is the life story of one who has rendered an outstanding service in the fields of aeronautics and thermodynamics during two world wars; who made important contributions to the teaching profession; and who has achieved high international standing as an engineer and a scientist.

At the age of 93 Dr. Durand relates with clarity and in a most entertaining style his early experiences as a cadet at Annapolis; his part as an engineering officer in the transition from wooden to steel warships; and his introduction to educational work through assignment to Lafayette College, which was followed by a memorable career in research and teaching at Cornell and Stanford Universities. During this period he invented a radial planimeter, introduced logarithmic graph paper and advanced the design of ship propellers.

In later years Dr. Durand, by then an acknowledged authority, served on many special engineering committees and standing bodies including the National Advisory Committee on Aeronautics, the Engineering Division of the National Research Council of which he was chairman, and as president of the World Power Conference held in Washington, D. C., in 1936. He took part in the design of both the Hoover and Grand Coulee Dams and is a past president of The American Society of Mechanical Engineers. His discussion of these various activities unfolds a picture of engineering progress during the last 75 years.

It is believed that the book will be widely read not only by former students and associates, but also by many with whom he came in contact in his long and varied career.

There are 212 pages attractively bound, and the price is $4.

Manual on Industrial Water

This manual is the result of the combined efforts of ASTM Committee D-19, its associates and other members of the Society. It is intended as a reference source for executives and plant designers; individuals engaged in industrial operations involving the use of water; also engineers, consultants and analysts.

The text deals with uses of industrial water, its composition, sampling and treatment, as well as analysis and identification of water-formed deposits.

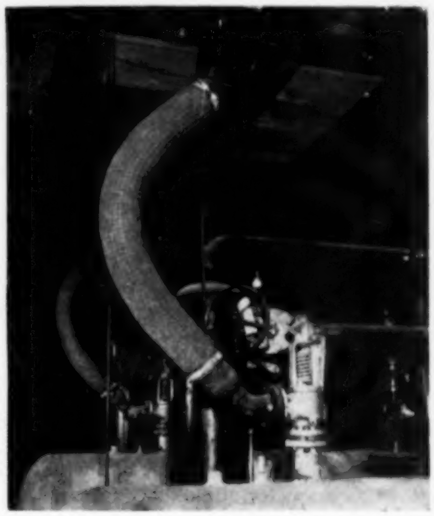
Standards that have been adopted by the Society on methods of sampling, analysis, testing, and of reporting results are included.

There are 344 pages with cloth cover and the price is $4.25.

New Equipment

Flexible Metal Assembly for Safety Valve Exhaust

The corrugated flexible metal hose assembly here shown, which extends from the safety valve to the exhaust pipe, eliminates the extreme noise and



possible injury to workers caused by unexpected discharging of safety valves. It is being manufactured by Flexonics Corp., Maywood, Ill.

Boiler Water-Level Gages.

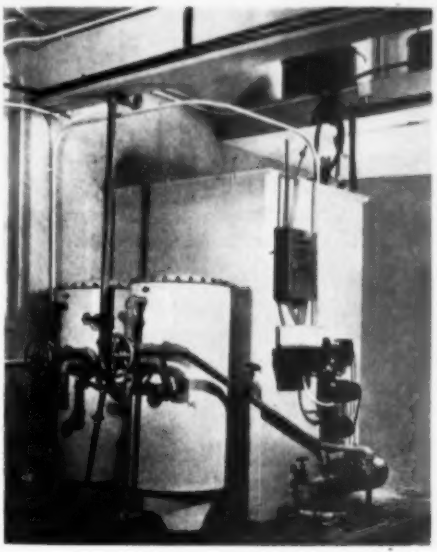
Greater dependability, longer gage life and more accurate water-level readings in high-pressure service are claimed for the new separated-design water gage assembly developed by the Yarnall-Waring Co. On gages for wide range of visibility greater flexibility is

gained by using two "floating assembly" type independent inserts, and by interconnecting expansion loops. On those for medium ranges, using one insert, a single expansion loop is used.

The lower flanged connection and the upper flanged loop connection result in the elimination of stuffing boxes. The short lower flanged connection eliminates the cold water leg, resulting in greater accuracy in level reading. The tie-bar-type water column linking the gage valves provides circulation to keep the gage nearer drum temperature.

Package Water Conditioner

A completely integrated package water conditioning plant is being put out by The Permutit Co., 330 West 42nd St., New York. These units may be used: (1) to remove turbidity, color and organic matter from water supplies; (2) to chlorinate; (3) to remove bad



odors; (4) to remove iron and manganese; (5) to neutralize; (6) to soften; and (7) to de-alkalize.

Each complete conditioner consists of a precipitator with a built-in clearwell, a proportioning chemical feeder control, a coagulant feeder tank, a lime or soda ash and hypochlorite feeder tank, inlet float control valve, neutralite filter, Carbo-Dur purifier and a service pump.

Return Idler

A new type of self-aligning belt-training return idler has been announced by the Chain Belt Co., Milwaukee 1, Wis. Identified as Rex Style No. 41, it provides automatic alignment for the return belt without the use of side-guide idlers. The idler consists of a dead-shaft roller-bearing return roll, mounted at each end to a toggle-like arrangement of swivel arms suspended from the conveyor framework at an angle of approximately 45 deg in the direction of belt travel. It acts to maintain an equilibrium condition and is said to be effective on horizontal, inclined or declined conveyors.

New Catalogs and Bulletins

Any of these may be secured by writing Combustion Publishing Company, 200 Madison Avenue, New York 16, N. Y.

Boiler Baffles

A four-page bulletin showing how streamlined baffles are applied to boilers of all types and sizes has been issued by The Engineer Company. Included in it are 21 drawings showing the installation of baffles in specific units and explaining advantages to be derived from the particular baffle constructions.

Motors and Generators

Allis-Chalmers Mfg. Co. has made available a 50-page pamphlet which is intended to assist in the selection of motors, generators and motor-generator sets to handle most industrial applications. It is reprinted from the 1952 edition of Lincoln's "Industrial-Commercial Electrical Reference" published by the Electrical Modernization Bureau, Inc.

Gear Motors

The function, design and application of gear motors are described in Publication GEA-1437H, a 16-page, two-color information guide prepared by the General Electric Company. Standard G.E. Tri-Clad gear motors with ratings from $^1/_6$ up to 200 hp are described. Cutaway photographs show the relative position of the parts which are distinctive to the design of each motor.

Gravity Filters

A comprehensive 24-page booklet, No. 2539A, shows the complete line of gravity filters as manufactured by The Permutit Co. Specifications, operating characteristics, outline dimensions and typical installations of these filters and associated accessories have been included in this new edition. The bulletin is very attractively illustrated and contains information useful to all interested in water-treatment problems.

Maintaining Control Equipment

What to look for in maintaining control equipment is told in an eight-page manual entitled "Proper Maintenance of Control" released by Allis-Chalmers Manufacturing Co. Besides giving helpful suggestions toward overcoming some of the most frequent difficulties common to such devices, the pamphlet, No. 14X7612A, has a handy control trouble-shooting chart for quick reference showing the symptom, possible cause and cure.

Meters and Controls

Bailey Meter Co. has made available Bulletin 18, a 16-page comprehensive catalog offering information on the complete line of meters, control equipment and engineering services offered by the company. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, illustrations and detailed literature references are included.

Centrifugal Pumps

Bulletin WQ-214 prepared by the Warren Steam Pump Co. describes the Type DF end-suction centrifugal pump, which is capable of handing capacities to 1000 gpm and heads to 400 ft. Design advantages are explained and there is a table of dimensions for these pumps which are adapted to handling water, solvents, brines, caustics, acids, oils and the like.

Package Boiler

Combustion Engineering, Inc., has made available a 16-page illustrated catalog describing the features of the new C-E Package Boiler, Type VP. Following an introduction which provides background information, there is a section outlining the principal features of the design of these boilers, which are completely shop assembled and provide steam capacities from 4000 to 30,000 lb per hr. Space requirements are shown in a table, along with typical specifications. A concluding section describes the automatic control system for the units.

Valve Catalog

The Lunkenheimer Co. has published a 506-page catalog which features a 24-page valve-selector guide and over 100 pages of reference data. Completely illustrated and thumb-indexed, the selector section of the catalog groups valves according to pressure classifications and enables engineers to find specifications, reference data and code requirements quickly. The attractively bound volume is being distributed personally by Lunkenheimer sales representatives and distributors.

Business Notes

Edward Valves Inc., East Chicago, Indiana, has named David MacGregor works manager in charge of manufacturing operations and industrial relations, in addition to his current duties as chief engineer. At the same time Carl L. Erwin, personnel manager, was advanced to the position of assistant works manager.

Diamond Power Specialty Corp. recently established a marine sales office at 165 Broadway, New York, under the supervision of H. L. Walker. Its present sales office at 37 W. 43rd St., New York, for handling other than marine sales, will continue.

Graver Water Conditioning Co., New York, has appointed A. H. Honeck district manager for the state of Ohio and the northern counties of Kentucky. He will maintain offices in the Citizen's Bldg., Cleveland, and at 3427 Corrine Ave., Cincinnati.

Johns-Manville Corp., New York, has established a public utilities section under the management of Edward D. Flavin who from 1946 to the present has been district manager in New York.

Peabody Engineering Corp., New York, has appointed John Dunn general sales manager, with responsibility for all the company's sales divisions in the Western Hemisphere and territorial representative companies.

Leeds & Northrup Co., Philadelphia, announces the election by its board of directors of I. Melville Stein as president, succeeding C. S. Redding who becomes chairman of the board. Mr. Stein was formerly executive vice president.

Copes-Vulcan Division of the Continental Foundry & Machine Co. has recently named The Hank Thurstin Co. to represent it in the Denver territory and Power Economy Inc. in Kansas City, Mo.

Pocahontas Fuel Co. Pocahontas, Va., has appointed Earl G. Robertson vice president in charge of sales. He was formerly vice president of the Pittston Company and chairman of the board of the Clinchfield Fuel Co. He will make his headquarters at the New York office of the Pocahontas Fuel Co.

Poole Foundry & Machine Co. has appointed the Kraver Industrial Sales Co. of Milwaukee as its representative in the state of Wisconsin and the eastern portion of Iowa.

BOOKS

1—Fuels and Combustion

By M. L. Smith and K. W. Stinson

330 pages Price $6.50

This textbook has as its worthy objective the presentation of fundamental and factual information concerning solid, liquid and gaseous fuels and the problems associated with their combustion. It covers the general topics of fuel technology and the relationship of air, fuel, combustion products and the heat released. The book is basically intended for undergraduate engineers studying a fuels and combustion course which would follow work in fundamental thermodynamics and precede the applied courses in steam power, internal combustion engines and heating and ventilating. However, the practicing engineer will find much valuable data compiled in concise form.

The opening chapter is devoted to all types of fuels. Then follows a very understandable treatment of stoichiometric analysis and thermochemical analysis. The process of combustion, including its mechanism and the manner of flame propagation, is next considered. Succeeding chapters take up physical properties of fuels, gas and oil burners, coal-burning equipment, and combustion in engines. An appendix includes a number of useful charts to aid in combustion calculations. At the end of each chapter there appears a list of stimulating questions and problems.

2—Steam Power Stations
Fourth Edition

By Gustav A. Gaffert

637 pages 6 × 9 Price $8.00

This well-known book was first brought out in 1937 primarily to familiarize mechanical engineering students with steam power equipment and practice; but aside from fulfilling this objective, it has found wide favor among practicing engineers.

That it has been found expedient to bring out four editions over a period of fifteen years attests to the rapid developments that have taken place in power plant practice during that period. In general, statistics, data and other information have been brought through 1950, which is about as late as can be expected in view of the time required for revision, proofreading and production. Three new chapters have been added, namely, a general discussion of power equipment, heat transfer and optimum cycles.

This fourth edition contains 433 illustrations and charts, including a Mollier Diagram, and many tables.

3—Elementary Heat-Power
Second Edition

By H. L. Solberg, O. C. Cramer and A. R. Spaulding

624 pages Price $6.50

The three authors have collaborated in the revision of this text which places its basic emphasis upon fuels as sources of energy, the functions of the equipment used for power generation, the construction of such equipment, and its actual performance. It is intended for the students who have studied physics and chemistry at the college level and whose mathematical training includes the calculus.

The major changes made in revising the book were directed toward bringing together as many fundamental concepts as were logically feasible in the opening chapter entitled "Matter and Energy." To these ends, consideration was given to a discussion of the English engineering system of units and dimensions, development of the general energy equation and its application to heat-power equipment in terms of the first law of thermodynamics, early introduction of the concepts of entropy and enthalpy, and the significance of the second law of thermodynamics in relation to energy degradation. The material on combustion calculations was rewritten with the purpose of stimulating analytical thinking and developing facility of calculation using the pound-mole. Descriptive material in the text has been brought up to date.

4—Technical Calculations in Heat Engineering

By James H. Potter

Paper-spiral-bound Price $2.25

Occasionally one comes upon a workbook intended primarily for student use in engineering schools that also has considerable value to the practicing engineer. Such is the case in this instance, for Professor Potter's book should be of considerable aid to the active engineer whose thermodynamics has become "rusty" and who wishes to make a systematic review, guided by a logical outline. The book contains 150 problems in heat engines and thermodynamics, one to a page.

5—The Science of Flames and Furnaces

By M. W. Thring

416 pages Price $6.50

Major emphasis of this British book is upon industrial furnaces. The author is head of the physics department of the British Iron and Steel Research Association and has also served on the staff of the British Coal Utilization Research Association.

The book tells how furnaces are built and how they function. Applications of the first and second laws of thermodynamics to furnace design are cited, and the rate and mechanism of heat release from fuels is considered. Sections are devoted to heat transfer and to the aerodynamics of hot systems. Two concluding chapters deal with the science of furnace construction and the application of scientific method to furnaces.

This book is primarily intended for the combustion research specialist rather than for the power plant designer.